ABSTRACT TEMPLATE

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Abstract Template

Production and properties of *Irpex lacteus* cellulase and xylanase

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Abstract

This study aimed to characterize the cellulolytic system of *Irpex lacteus* BCC 104 isolated from the forest of Georgia. The results obtained showed that the expression of endoglucanase and xylanase synthesis in this fungus is inducible in the presence of cellulose-containing growth substrates. Among them, crystalline cellulose appeared to be the best carbon source providing the highest endoglucanase (48.0 U/mL), total cellulase (7.6 U/mL), and xylanase (68.4 U/mL) activities. Supplementation of the Avicel-induced culture with 0.5 or 1% glycerol caused catabolite repression of the cellulase and xylanase formation by *I. lacteus* BCC 104. The enzyme synthesis resumed only after the depletion of easily metabolizable carbon source from the medium. The crude enzyme obtained after the cultivation of *I. lacteus* in the fermenter and used for saccharification of pretreated wheat straw (40 mg/mL, FPA load 20 U/g substrate) yielded 10.7 mg reducing sugars/mL (32.2% from the theoretically possible). CMCase and xylanase were purified 31- and 34-fold and characterized. The optimum pH for both enzyme activities was found to be 5.0; at pH 5-6, they retained 60% of their initial activity after incubation at 30°C for 48 h. CMCase expressed maximum activity at 50°C while xylanase – at 55°C. Half-inactivation periods of endoglucanase and xylanase during incubation at 60°C were 60 min and 150 min, respectively.

Keywords: *Irpex lacteus*, Cellulase, Xylanase, Production, Purification, Properties

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Conflict of interests

The authors have no conflicts of interest to declare.

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ORIGINAL/RESEARCH PAPER TEMPLATE

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Research /Original Paper Template

Modeling of 1D sediment transport in the langat river using quasi-unsteady HEC-RAS

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Abstract

The primary goal of this research was to investigate the sediment transport characteristics of the Langat River. The Langat River is situated in the state of Selangor, Malaysia, and is prone to flooding on a regular basis. The River Analysis System tool from the Hydraulic Engineering Center (HEC-RAS) was used to determine sediment transport capacity of the river. The sediment transport and hydraulic models were created using elevation and cross-sectional data in HEC-RAS. The sediment transport model employed several approaches to calculate sediment transport capacity. HEC-RAS contains some useful built-in functions which were used in this study to visualize the sediment transport, calibration and calculation of Manning's roughness coefficients, and forecast changes in bed elevation. The investigation reveals that urban development has resulted in a large rise in riverbed depth, implying that is no difference in flooding pattern in the short period of time. This paper focuses only on bed load sediment. The results of three years of stream flow show that some areas have experienced silt transport and river deposition. The river had changed slightly after utilizing the Laursen-Copeland method in HEC-RAS. The simulation outcome shows the segment that experienced sediment transport at River Stations RS 12926 from Lui, RS 9362 from Langat upper reach, and RS 3730 from Langat Lower Reach are experiencing sediment deposition activities.

Keywords: HEC-RAS, Sediment, Sediment transport, Deposition

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1 Introduction

Eroded sediments can be found in any of three forms in rivers that transport water: bed load, suspended load, or wash load. Rivers are subjected to significant deposition and bank erosion due to natural and anthropogenic forces (Simons and Şentürk, 1992). Depending on the location and hydrological regime, the effects of erosion and deposition can cause significant changes in river geomorphology in long-term. The conveyance of silt alters the river reach's capacity. Siltation and navigation issues in rivers are caused by increased soil erosion. Several factors influence sediment transport in rivers, including particle size and type of sediment, drainage area size, vegetation and land usage, river basin, climate change behavior and temperature, flood occurrence, and land slope.

Sediment is one of the most important variables affecting the morphology of rivers in Malaysia. One of the key problems of hydraulic structure constructions (i.e., dam, irrigation canal), or the use of river for navigation purposes is the physical characteristics of sediment delivered within reach. As Langat River is used for navigation purposes, the riverbed built-up that has resulted in shallow depth may have an impact on its use. To alleviate the problems caused by changes in river morphology, it is necessary to examine sediment flow and riverbed features. The river reach is chosen depending on the available gauged stations and the settlement's proximity. The hydraulic analysis of the sediment transport model was developed using HEC-RAS in this study. The geometric data were created in ArcGIS using the HEC-GeoRAS extension from a 30m × 30m meter resolution digital elevation model. Two sediment transport functions (e.g., Laursen and Rubey methods) and Manning's roughness coefficients were used for model calibration and validation. The output of the model shows the change pattern of riverbed and river reach subjected to erosion or deposition. The output of the model can serve as a guide for the relevant authorities to mitigate the sediment-related problem.

Numerical models (from one-to-three dimensional) have been established in recent years to reproduce realistic processes. One-dimensional model is preferred by many due to its simplicity that leads to shorter computations and calibration time, a reduced amount hydrologic data for model evaluation (Horritt and Bates, 2002). Changes in streamflow have an impact on the amount of silt transported downstream and the severity of water shortages (Pitlick and Wilcock, 2001). Climate variability corresponds to streamflow variability, which enhances the hydrological cycle's uncertainty (Lee et al., 2018). According to Kalra et al. (2017), the timing of the peak flow varies due to variabilities. HEC-RAS is a powerful hydraulic modelling tool for runoff simulation based on river characteristics (Abdessamed and Abderrazak, 2019). Despite the uncertainty of extreme occurrences, its 2D numerical analysis is effective for flood modelling (de Arruda Gomes et al., 2021).

2 Materials and Methods

2. 1. Study area

With the expansion of Putrajaya, which is the administrative and judicial capitals of

Malaysia, the upper part of the Langat River has been designated as a study area and has recently become a key source of sand for buildings. The Langat River basin is located in the south and southeast of the state of Selangor, as well as minor areas of Negeri Sembilan and Kuala Lumpur. The basin is bordered on the east by the Main Range Titiwangsa and on the west by the Straits of Malacca. The basin's geography is varied, ranging from mountainous areas in the northeast to lowland areas in the centre and lowlands in the south-west. The river system runs through the three states of Malaysia, i.e. Selangor, Negeri Sembilan, and Putrajaya. The total length of Langat River is about 180 km and its river basin covers 2,350 km^2 and has a mean annual discharge of 35 m^3/s, with a mean annual flood of 300 m^3/s (Ghani et al., 2011). The Langat River is used for a variety of activities other than water delivery, including recreation, fishing, waste disposal, irrigation, and sand mining.

2. 2. Methodology

To accurately replicate the sediment transportation of a particular river reach, the HEC-RAS 5.0.1 was fed with precise input data of Digital Elevation Model (DEM), discharge, gauge height, sediment/sediment load series, and temperature. One-dimensional hydraulic model was used to generate the water surface profiles, including sediment aggradation, riverbed depth analysis, and erosion. Quasi-unsteady flow data was used to simulate sediment transport. The processes for pre-processing data and preparing the computational domain were defined by the general approach to numerical modelling. The simulation's result was determined by post-processing the acquired data by running the model and visualizing the results. Three categories input data were used as simulation input: geometric data (as per Table 1), quasi-unsteady flow data, as well as sediment data. The boundary conditions for the simulation as stated in Table 1.

Table 1. Observation field data for Langat River (Ghani et al., 2011)

Study area	Study area Langat River
Q (m^3/s)	2.75–120.76
V (m/s)	0.23–1.01
B (m)	16.4–37.6
Y_o (m)	0.64–5.77
A(m^2)	8.17–153.57
R (m)	0.45–3.68
S_o	0.00065–0.00185
d_{50} (mm)	0.31–3.00
Manning n	0.034–0.195

A DEM, which defines the height of any specific point within a given geographical boundary was used to establish the topography of the study area in 3D. The DEM with a resolution of 30 m × 30 m was obtained from the Shuttle Radar Topography Mission (SRTM). DEM for the research region was masked with ArcGIS 10.2's geo-processing extension topographic factors such as basin shape, stream network flow direction, etc. were extracted to produce geometric data such as stream centerlines, flow paths, and bank lines; reshaping was

done when needed, and the attributes were grouped in HEC-GeoRAS. After completing the layer setup, the stream centerline attribute was filled in. RAS Geometry was used to populate the cross-section cut lines property, which was digitized as shown in Figure 1. Then, for the RAS GIS Import File, all these files were created.

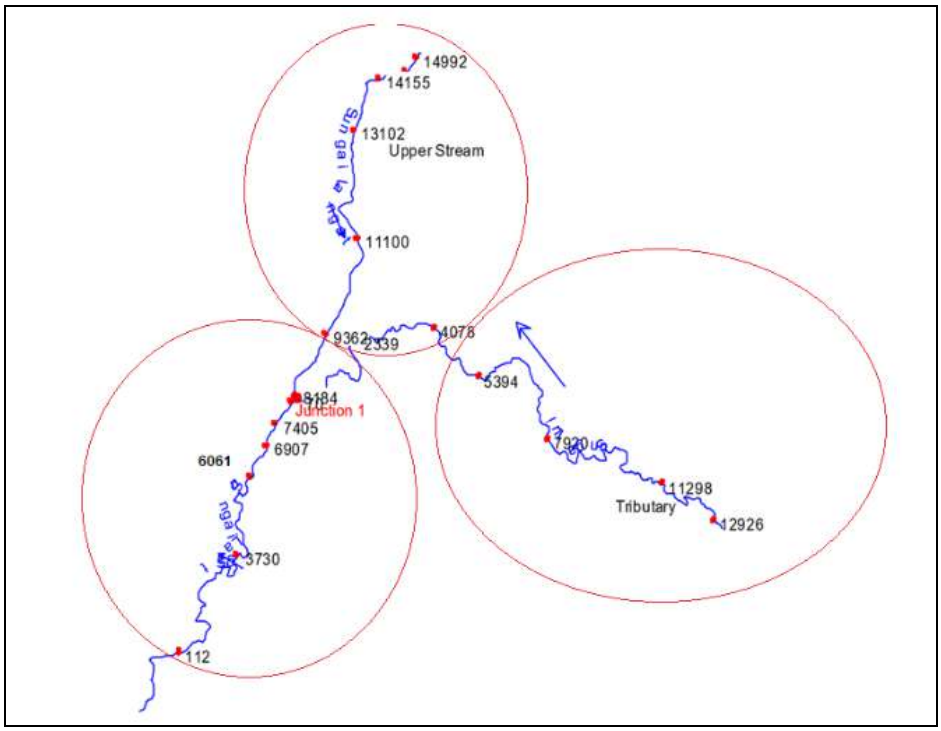

Figure 1. LRB upstream, downstream, and tributary with bank points

Sediment data boundary conditions used were Sediment Load Series for both Lui River and Langat River upper reach river stations. The sediment transport computation equation used in Laursen-Copeland method (Mohammed et al., 2018) is shown below. Likewise, fall velocity computational equation used in the Rubey method (Molinas and Wu, 2001) of HEC-RAS is also utilized for the simulation of the sediment model and is explained below.

$$C_m = 0.01\gamma \left(\frac{d_s}{D}\right)^{\frac{7}{6}} \left(\frac{\tau_0'}{\tau_w} - 1\right) f\left(\frac{u_0}{\omega}\right)$$

where: `

C_m = concentration of the sediment discharged (tonnes/day)

γ = unit weight of the water

d_s = Mean particle diameter

D = mean particle diameter

τ_0' = bed shear stress due to grain resistance

τ_w = critical bed shear stress

ω = particle fall velocity (m/s)

u_0 = shear velocity (m/s)

Laursen method predicts the total sediment load value. The applicable particle size used for this formula is within a range of 0.011 mm to 29 mm (Hamzah, 2014). Hence it is feasible to be used for this project. The equations to be used for the Rubey method of Fall Velocity are as follows:

$$\omega = F_1\sqrt{(s-1)gd}$$

$$F_1 = \sqrt{\frac{2}{3}+\frac{36\nu^2}{gd^3(s-1)}} - \sqrt{\frac{36\nu^2}{gd^3(s-1)}}$$

where:
ν = Kinematic viscosity
s = Specific gravity of particles
d = Particle diameter
g = Gravitational acceleration (m/s^2)

3 Results and Discussions

The HEC-RAS model was calibrated using the automated Manning's value. The initial values entered, will be a placeholder for the automated routine to start from. The manning's value chosen for the Langat River Basin is 0.035.

3. 1. Annual sediment load observation for year 2015, 2016, 2017

Figure 2 shows of the sediment load discharge (kilotons/day) plotted against time to observe the changes of the riverbed throughout the research duration. It can be observed that the highest cumulative annual sediment load was recorded in the year 2015. This amounts to a total of 20957.39 tons per day of transported load of sediment. It can also be seen that the sediment load transported has gradually decreased over the years of 2015 to 2017. The highest value was found in the Langat River Basin (LRB) Lower Stream (LS). The lowest sediment load value observed was 948.98 tons per day in year 2017 in Lui.

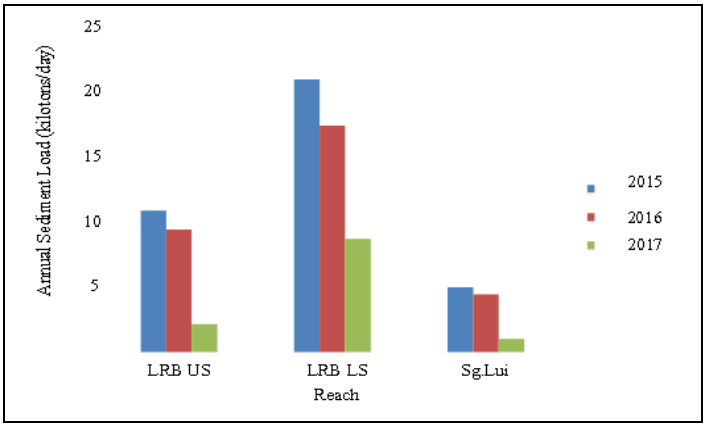

Figure 2. Annual sediment load (kilotons/day) for 3 reaches of LRB

3. 2. Critical bed-changes and erosion level found in the sediment output of the river reaches

The critically affected areas of the riverbed due to sediment transportation were analyzed based on the output of HEC-RAS, showing the changes which occurred in river profile and cross-section for each reach of upper LRB. The changes were compared for both dry (SW monsoon) and wet (NE monsoon) seasons separately to observe the level of erosion and deposition of sediments occurring in the river cross sections. For this comparison, River Station, RS 12926 from Lui, RS 9362 from Langat upper reach, and RS 3730 from Langat Lower reach were used as they showed the largest changes in the channel bed elevation. These bed changes can be better understood by observing the results as shown in Figures 3 to 5. The results conclude that the erosion level or degradation of channel bed was the highest in the year 2016. Followed by 2015 and 2017. Figure 3 depicts an increase in the levels of the riverbed throughout the 2015 to 2017 duration. While the increase in elevation of riverbed was 0.14 m in 2016, the riverbed appears to have a deposition of sediments. The deposition in 2015 is observed as the second highest with a 0.11 m increase in elevation. It is clearly shown that the lowest value was obtained for 2017.

On the other hand, Figure 4 shows the changes occurring in cross-sectional elevation of the river over a period of 3 years for the RS 9362 of Langat. This is the upper reach of Langat River, connecting to the downstream through a junction. Results concluded that the erosion level or degradation of channel bed was the highest in the year 2016. Followed by 2015 and 2017. It also shows an increase in the levels of the riverbed throughout the 3 years for RS 9362 of the upstream LRB of upper reach. The largest increase in elevation of riverbed was 0.15 m in 2016 with a deposition of sediments. The deposition in 2015 is observed as the second highest with a 0.12 m increase in elevation. It is clearly shown that the lowest value was obtained as 0.09 m deposition for 2017.

The RS 9362 of Langat is the upper reach of Langat River, connecting the downstream through a junction. Results concluded that the erosion level or degradation of channel bed was the highest in the year 2016. Followed by 2015 and 2017. Figure 5 shows an increase in the levels of the riverbed throughout the 3 years for RS 3730 of the downstream LRB of lower reach. Hence, showing a negative erosion level. The largest increase in elevation of riverbed was 1.2 m in 2016 with a deposition of sediments. The deposition in 2015 is observed as the second highest with a 0.8 m increase in elevation. It is clearly shown that the lowest value was obtained as 0.15 m deposition for 2017. The values for bed change in RS 3730 of lower river reach appear to be highest among the other river reaches for SW monsoon. Meanwhile the values for bed change in RS 12926 of Lui reach is observed as the lowest.

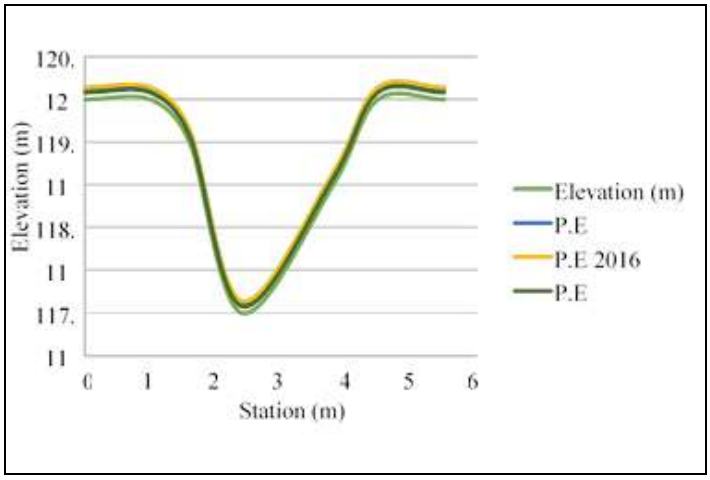

Figure 3. Potential erosion at LRB tributary, RS 12926, Lui

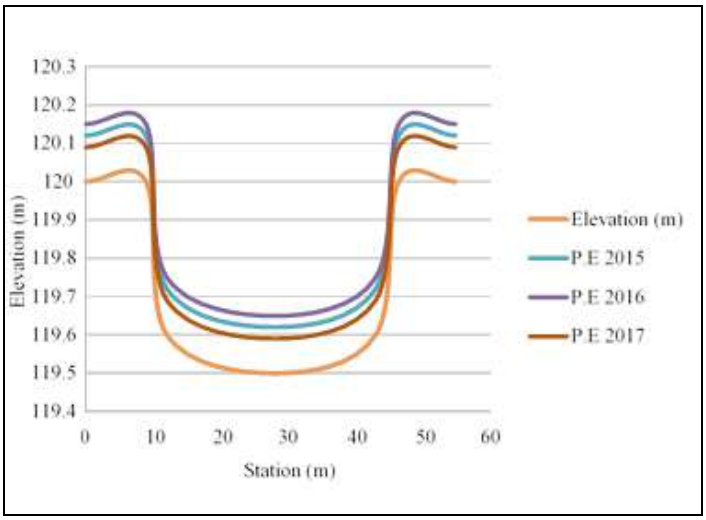

Figure 4. Potential erosion at LRB upstream, RS 9362, upper reach

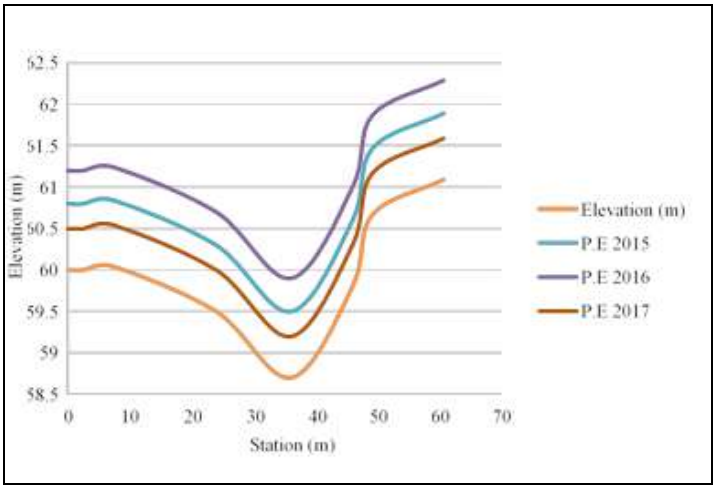

Figure 5. Elevation and potential erosion (P.E) of RS 3730, lower reach

4 Conclusion

The HEC-RAS model, along with RAS Mapper, is used in the sediment transport analysis. Sediment load analysis is discussed by showing the relationship between sediment load and time for each river reach. Seasonal trend analysis of the river reaches shows that the SW monsoon duration showed less sediment load compared to the NE monsoon. The lower reach of LRB showed the highest value during the month of October, with a value of 166700 tons/month sediment load in 2016. Critical area identification results show a higher chance of the upper reach of the LRB undergoing erosion and the lower reach of the LRB undergoing deposition. Deposition occurs in the NE monsoon season when the rainfall and river flow are relatively high. Since the upstream areas face a higher river flow, they are more prone to erosion of the riverbed level. Erosion is more prone to occurring in the SW monsoon season or dry season when river flow is low due to low rainfall. Hence, the sediment particles will settle and form a deposit on the riverbed. Overall observation depicts that RS 12926, RS 9362, and RS 3730 are the critical river stations that reported deposition during the monsoon season.

The erosion and deposition trend of the riverbed must be considered before constructing any hydraulic construction. The sediment transport model by HEC-RAS presented in this work depicts the movement of sediment transport in terms of erosion and deposition in Langat River Basin. The sediment transport capacity estimated by this model is useful for river management in long-term. The results of bed load and sediment load changes in the river cross-sections can aid in the development of a more robust model for predicting future sedimentation scenarios.

This study is vital in determining the capacity of Langat River reach, as well as the nature of the river and its physical properties, which can assist the relevant authorities in river management. Stream bank stabilization could be one of the most effective ways to reduce erosion rates while simultaneously benefiting aquatic habitats such as fish, plants, and macroinvertebrates.

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Conflict of interests

The authors state that there are no conflicts of interest regarding the publication of this article.

References

Abdessamed, D., & Abderrazak, B. (2019). Coupling HEC-RAS and HEC-HMS in rainfall–runoff modeling and evaluating floodplain inundation maps in arid environments: case study of Ain Sefra city, Ksour Mountain. SW of Algeria. *Environmental Earth Sciences*, *78*(19), 1-17. https://doi.org/10.1007/s12665-019-8604-6

de Arruda Gomes, M. M., de Melo Verçosa, L. F., & Cirilo, J. A. (2021). Hydrologic models coupled with 2D hydrodynamic model for high-resolution urban flood simulation. *Natural Hazards*, *108*(3), 3121-3157. https://doi.org/10.1007/s11069-021-04817-3

Ghani, A. A., Azamathulla, H. M., Chang, C. K., Zakaria, N. A., & Hasan, Z. A. (2011). Prediction of total bed material load for rivers in Malaysia: A case study of Langat, Muda and Kurau Rivers. *Environmental Fluid Mechanics*, *11*(3), 307-318. https://doi.org/10.1007/s10652-010-9177-9

Hamzah, M. H. B. (2014). Study The 1d Quasi Jing Of Sediment Transport In Galing River By Using Hec-Ras (Doctoral dissertation, UNIVERSITI MALAYSIA PAHANG).

Horritt, M. S., & Bates, P. D. (2002). Evaluation of 1D and 2D numerical models for predicting river flood inundation. *Journal of Hydrology*, *268*(1-4), 87-99. https://doi.org/10.1016/S0022-1694(02)00121-X

Kalra, A., Sagarika, S., Pathak, P., & Ahmad, S. (2017). Hydro-climatological changes in the Colorado River Basin over a century. *Hydrological Sciences Journal*, *62*(14), 2280-2296. https://doi.org/10.1080/02626667.2017.1372855

Lee, S., Yeo, I. Y., Sadeghi, A. M., McCarty, G. W., Hively, W. D., Lang, M. W., & Sharifi, A. (2018). Comparative analyses of hydrological responses of two adjacent watersheds to climate variability and change using the SWAT model. *Hydrology and Earth System Sciences*, *22*(1), 689-708. https://doi.org/10.5194/hess-22-689-2018

Mohammed, B. A., Sharfi, E. S. M., & Mordos, M. A. (2018). Simulation of River Bed Changes Upstream Merowe Dam. *University of Khartoum Engineering Journal*, *8*(1).

Molinas, A., & Wu, B. (2001). Transport of sediment in large sand-bed rivers. *Journal of Hydraulic Research*, *39*(2), 135-146. https://doi.org/10.1080/00221680109499814

Pitlick, J., & Wilcock, P. (2001). Relations between streamflow, sediment transport, and aquatic habitat in regulated rivers. *Geomorphic Processes and Riverine Habitat*, *4*, 185-198.

Simons, D. B., & Şentürk, F. (1992). *Sediment Transport Technology: Water and Sediment Dynamics*. Water Resources Publication.

REVIEW PAPER TEMPLATE

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Review Paper Template

Health tourism training and education and COVID-19 pandemic

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Abstract

Health tourism focuses primarily on physical health and also improves mental and spiritual well-being and increases the capacity of people to meet their needs and better performance in their environment and society. Education and training in health tourism is very important because it reduces medical errors and increases the satisfaction of health tourists. Recently, health tourism as well as health tourism training have been negatively affected by COVID-19 epidemic. The outbreak of coronavirus since January 2020 has severely affected many industries. Tourism education provided by universities, which requires close links with the tourism industry, has also been strongly influenced. The prevalence of COVID-19 is a major barrier to the tourism industry and education system. Although tourism education has been changed from face-to-face education to online education during COVID-19 epidemic, online education has serious constraints and cannot replace face-to-face education. In this review we aim to investigate the health tourism and health tourism education and training during COVID-19 pandemic.

Keywords: Tourism, Education, COVID-19, Mental well-being

1 Introduction

1. 1. Health tourism

Tourism is a service activity that refers to the movement of people from one geographical location to another. Tourism is also a social, cultural and economic phenomenon that involves

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the movement of people to countries or places outside their normal living environment for personal or commercial / professional purposes. Tourism plays an essential role in the social, cultural and economic development of most countries (Hamid et al., 2021). This service industry includes various types of tourism, of which health tourism is one of the most effective types of foreign exchange earnings of countries. Health tourism is a type of tourism that focuses primarily on physical health and also improves mental and spiritual well-being and increases the capacity of people to meet their needs and better performance in their environment and society (Salehi Isfahani et al., 2021). Health tourism has attracted the attention of research centers and industry due to its benefits in physical and mental health (Yin et al., 2021). But health tourism has been seriously affected with the COVID-19 pandemic. COVID-19 was first reported on December 31, 2019 in Wuhan, China and has since become a global epidemic. COVID-19 is rapidly transmitted between humans; Thus, physical distance has been identified as a key factor in reducing its spread, and most countries around the world have introduced quarantine and travel bans, cancellation of social events, and closure of public services to curb COVID-19 (Ellis et al., 2020). Accordingly, the prevalence of this disease is considered as an effective factor in reducing tourism, including health tourism. According to studies, the COVID-19 epidemic has negatively affected many different sectors of tourism and has shut down the industry for months. Although various efforts have been made since June 2020 to reopen the industry, most sectors are still facing problems. The World Tourism Organization has acknowledged the enormous damage to the tourism industry due to COVID-19 pandemic (Collins-Kriner and Ram, 2020).

1. 2. COVID-19 pandemic

According to the researchers, coronavirus not only causes significant illness and death, but also causes major disorders at the local, national and global levels. Although health care is growing during the epidemic, travel is disrupted. It has affected health tourism and has reduced the travels and trips (Chhabra et al., 2021). It has been reported that the world has experienced a major crisis due to COVID-19, and most industries, especially the health tourism industry, have also faced major negative effects (Sharma et al., 2020). In fact, the outbreak of coronavirus has reduced both the number of entries and the volume of health tourism services (Ananchenkova, 2021). The growing COVID-19 crisis has had a severely negative impact on the tourism industry through a combination of trade and health regulations, and while the tourism industry has faced a number of crises in the past (Abbaspour et al., 2021), it is predicted that this the crisis will continue until the end of 2021 (Kosaka et al., 2021).

1. 3. COVID-19 and health tourism

The study of the effect of COVID-19 on health tourism has been discussed from different aspects. The present study was conducted to address some of these challenges regarding the effect of the Corona virus on health tourism. The results of these studies showed that the COVID-19 pandemic could reduce the number of health tourists. Many studies have shown that the prevalence of viral diseases is of significant hindrance in attracting tourists, especially health tourists. In the midst of COVID-19 crisis, tourism researchers, while paying attention to communities in tourism destinations, also pay attention to their safety and well-being and the

costs that will be incurred due to the cessation of tourism activities (Qiu et al., 2020). Also, according to studies, crises are regular events in tourism. Many destinations have been affected by natural and man-made crises and over the years, have developed flexible tactics and strategies (Ritchie and Jiang, 2019). However, the crisis caused by the COVID-19 epidemic has been different and unique in many ways. First, it has reduced travel, hospitality and tourism around the world (UNWTO, 2020); and second, the more dramatic economic collapse. The growing crisis of COVID-19 with a combination of trade and health regulations has severely affected the tourism industry, while the tourism industry has faced several crises in the past (Abbaspour et al., 2021; Kosaka et al., 2021). Recently, Yang et al. (2020) developed the DSGE "dynamic random general equilibrium" model to understand the impact of the epidemic on global tourism. The application of this model to COVID-19 indicates a significant decrease in tourism demand in response to an increase in health risk. Research findings also show that the world is still currently in the grip of the COVID-19 epidemic, which has halted the tourism sector and created an unprecedented global economic crisis. Countries compete with different motivations to attract visitors. However, sustainable early waves have reduced tourism revenues and accelerated job loss and bankruptcy in affected countries. With a ban on international travel that has affected more than 90% of the world's population (Grech et al., 2020). The World Tourism Organization estimates that due to the reduced communications, in-flight social distance (with aircraft only half full) and other industry constraints due to the continued presence of the virus (Gössling et al., 2020) and a reduction of 80 percentage of international tourism (BROM 2020), the tourism industry faced a reduction about trillions of dollars in revenue by 2020 (UNWTO) and the hospitality industry, which accounts for 300 million jobs and approximately 10% of global GDP (Brom, 2020) was collapsed. The results of a study by Flexman et al. show that major non-pharmaceutical interventions—and lockdowns in particular—have had a large effect on reducing transmission (Flexman et al., 2020)., and hence, on tourism. It has been reported that the epidemic of COVID-19 has significantly stopped the world tourism industry in 2020 (Stackpole et al., 2021).

The COVID-19 epidemic has had a negative impact not only on the economy but also on the physical and mental health of the people (Ma et al., 2021). The impact of global infectious diseases, including COVID-19, on the tourism industry in South Korea has been studied and studies have shown that the outbreak of this infectious disease has significantly reduced the number of incoming tourists to South Korea. Medicine and re-entry into the global market, including the Korean quarantine model that succeeded in preventing COVID-19, could be a preventive response to another pandemic in the future. The policy of the medical tourism industry based on the Korean quarantine model will help revive the international medical tourism industry after COVID-19 (Seo and Kim, 2021).

1. 4. Tourism education

Training is a major part of an organization's strategy to improve the performance, abilities, skills and behavior of its employees, the implementation of training must be properly managed to achieve the goals or benefits of training effectively. Training itself is a short-term training process that uses a regular and organized procedure. This definition indicates that training is an activity designed to develop human resources through a set of activities of identification,

evaluation, and a planned learning process. Holding a training course definitely has its own goals. The goals of the training provided by the company include increasing productivity, improving quality, supporting human resource planning, increasing members' morale, providing indirect compensation, promoting occupational health and safety, preventing the expiration of skills and knowledge, and increasing the competency of participants in training. With the complexity of the training objectives to be achieved, it is necessary to have a professional training management in order to achieve the training results effectively and efficiently (Ingkadijaya et al., 2021).

The tourism industry is a very important driver of the global economy and is affecting societies around the world that are currently experiencing fundamental change. Responding to these changes requires economic paradigms and education systems based on new foundations. Humanistic tourism proposes a values-based disciplinary approach to tourism at the intersection between human management and tourism and is rooted in human dignity and social welfare. Integrating the principles of human management into higher education tourism management programs, and changing the nature of what is taught and how it is taught, will benefit students, future managers and all stakeholders (Della Lucia et al., 2021). Tourism education should complement the new theoretical and managerial perspectives that address the world in transition, because knowledge creation through innovative teaching-learning processes guides research, practice, and behavioral flows at different levels (Pirson et al., 2019). Tourism education needs to be redesigned. This redesign can greatly benefit from the integration of human management principles in education and tourism management. The value-oriented perspective of humanistic management is crucial to clarify the ethical and sustainability issues identified by the contradictions and crises of the tourism industry in developed and developing countries, and to address issues (Della Lucia et al., 2021). Universities as sources of innovative thinking and change at the highest level must play an important role in building the capacity of tourism students and future managers to lead the industry, which is facing increasing pressures to become responsible stewards, now and in the future (Giudici et al., 2020). In addition, current and future managers and entrepreneurs need to adopt value-based leadership models that pave the way for business practices that ultimately serve human goals and respect human dignity (Santonino, 2020). Organizing an activity / event requires careful organization from planning, execution to evaluation of activities. These steps are needed to measure the success of these activities (Punia and Kant, 2013). Many factors can affect the effectiveness of a training, including performance management and the environment of the training environment that can create a favorable learning environment (Mohanty et al., 2019). The growing growth of the tourism industry in recent decades has created a great demand for higher education in hospitality and tourism. Given that the ultimate goal of higher education in hospitality and tourism is to provide professional talents to the tourism industry, curriculum design and training model with traditional courses Is different (Ye and Law, 2021). Many academics emphasize that hospitality and tourism education should not only focus on theoretical curricula, but should also provide opportunities for practice at the local and global levels (Liburd et al., 2018).

1. 5. Health tourism training

The globalization of health care has given rise to a new form of tourism, commonly known as health or medical tourism. Medical tourism has grown rapidly and many countries are already planning for this part of tourism (Ruggeri et al., 2015). Medical tourism is a situation in which tourists seek alternative medical opportunities in other countries. Medical tourism is the use of services that improve or enhance health through medical interventions in an out-of-residence area that lasts more than 24 hours, until recently it was very difficult to understand the difference between international and medical tourists. Medical tourists leave their country of origin to receive effective medical services (high quality and low price). The industry has grown rapidly in the last two decades, and due to the high foreign exchange earnings in this industry, many countries are actively planning to enter this field. In a strategic and competitive environment, development needs to be strengthened and it must also strengthen its supporting industries (Daniel et al., 2017).

1. 6. Health tourism education and quality of health tourism

Today, human life is accompanied by amazing changes. Organizations must be prepared to face these huge changes. The purpose of this preparation should not be just the provision of technology and equipment. Rather, the employees of the organization must be experts, which is an important and valuable asset. A successful organization pays more attention to human resources, which can be the key to its success (Abbaspour and Badri, 2016). Education in medical tourism is very important because it reduces medical errors and increases the satisfaction of medical tourists (Kacha et al., 2016). Training is a tool to improve the quality of performance, solve management problems, empower an organization's manpower and increase efficiency. Training programs should be developed for the effective performance of relevant individuals who have specific roles and responsibilities in the tourism and healthcare sectors (Daniel et al., 2017). Better integration and synergy between tourism education and industry will lead to the goal of sustainable development (Tiwari et al., 2021).

1. 7. COVID-19 pandemic and health tourism training

The outbreak of coronavirus since January 2020 has severely affected many regions and industries. Hotel and tourism education provided by universities, which requires close links with the tourism industry, has also been strongly influenced. The COVID-19 pandemic is a major barrier to the tourism industry and education system. Fortunately, learning of the SARS outbreak in 2003, hospitality and tourism educators have consistently adapted response measures to the unknown pandemic situation and made every effort to maintain the functioning of the education system. Hence, hospitality and tourism education in this period has changed from face-to-face education to online education. Most training classes, seminars and workshops are held online to reduce unnecessary face-to-face activities (Ye and Law, 2021). Although many studies have analyzed the impact of the epidemic on the tourism industry and numerous suggestions have been made to revive this sector, tourism education has been largely ignored. Tourism and family courses offered by higher education institutions are essentially part of the tourism system. Instructors need to be able to deliver training courses in a variety of ways that enable them to cope with the short- and medium-term effects of teaching in the

COVID-19 era, while also being proficient in predicting the future (Tiwari et al., 2021). The current situation of the COVID19 epidemic has highlighted the vulnerability of tourism. Sustainable tourism must be fully implemented to deal with this and other crises. And sustainable tourism education must accompany this process, especially in terms of students' professional skills that are necessary to overcome crisis situations (Mínguez et al., 2021). Education can provide learners with the knowledge, values, and skills needed to understand the complexity of sustainability (Berjozkina and Melanthiou, 2021). To overcome these consequences, many studies have shown the importance of digital education. Transformation in education, especially in tourism education, has a significant impact on fostering a desire for learning and love of tourism students at a time when the tourism industry is declining due to COVID19 epidemic (Trong et al., 2021).

1. 8. Health tourism education and the post COVID-19 period

At present, with the onset of an evolving world following the outbreak of COVID-19, changes in work styles, skill requirements, industry expectations and priorities are significantly anticipated (Séraphin and Yallop, 2021). The academic community has conducted conceptual and perceptual research to predict the post-COVID-19 period (Zheng et al., 2020). After a critical analysis, it was found that one of the broad topics around which research in tourism and hospitality is conducted is "the evolution of tourism" (Prideaux et al., 2020). Considering the change in consumer behavior, there is a need to redefine tourism (Wen et al., 2020), by adopting a community-focused approach (Higgins-Desbiolles, 2020) in the tourism and hospitality sectors (Zheng et al., 2020). Some studies have focused on describing the post-COVID-19 scenario in different countries (McCartney, 2021). Some researchers believe that the epidemic is an opportunity for the tourism industry to reset or revise itself (Lapointe, 2020). Seraphin (2020) believe that tourism education has a strong transformative potential in the current situation. Increasing pressure on the tourism industry to play a leading role has led to the Future Tourism Education Futures Initiative. The TEFI framework is a value-based tourism education program recognizing the need to guide tourism to the future in a positive, responsible and effective way. Ethics, knowledge, stewardship, professionalism and reciprocity are five interrelated values that should govern the development of the tourism world, and a tourism education program should be considered to train responsible leaders (TEFI 2010). These principles are interrelated and show permeability. COVID-19 has influenced the delivery of training courses and, most importantly, their need to master the use of new technologies for teaching. In the post-COVID-19 phase to transform tourism education, a two-pronged management approach that balances innovation in tourism education, it is suggested. The nature of tourism education is inherently multidisciplinary, suggested in the post-COVID-19 phase. Students should be encouraged to use the multifaceted aspects of their degree and work in different departments to remain flexible (Wen et al., 2020). The tourism education sector needs government and industry support to rebuild trust among students. Governments should plan by following international organizations such as the UNWTO, which has provided a technical assistance framework to strengthen industry (UNWTO, 2020). Online programs for developing students' skills, designing curricula with industry collaboration, and developing faculty for technical knowledge lecturing should be welcomed in the post-COVID-19 recovery phase. In addition,

badges and certificates can be used to motivate them to fill the skill gap among tourism graduates. This form of accreditation provides an opportunity for graduates to develop skills that are considered critical to the tourism industry (Tiwari et al., 2021).

2 Conclusion

Education and training in health tourism is very important because it reduces medical errors and increases the satisfaction of health tourists. Health tourism as well as health tourism training have been negatively affected by COVID-19 epidemic. Tourism education provided by universities, which requires close links with the tourism industry, has been strongly influenced and the COVID-19 pandemic. Considering the change in consumer behavior after COVID-19 pandemic, there will be a need to redefine health tourism by adopting a community-focused approach in the health tourism training.

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Conflict of interests

The author has no conflicts of interests to declare.

References

Abbaspour, A., & Badri, M. (2016). The relationship between psychological empowerment and effective factors of productivity of human resources.

Abbaspour, F., Soltani, S., & Tham, A. (2021). Medical tourism for COVID-19 post-crisis recovery?. *Anatolia, 32*(1), 140-143. https://doi.org/10.1080/13032917.2020.1815067

Ananchenkova, P. I. (2021). The impact of COVID-19 pandemic on medical tourism development. *Problemy Sotsial'noi Gigieny, Zdravookhraneniia i Istorii Meditsiny*, *29*(2), 203-205. doi: 10.32687/0869-866x-2021-29-2-203-205

Berjozkina, G., & Melanthiou, Y. (2021). Is tourism and hospitality education supporting sustainability?. *Worldwide Hospitality and Tourism Themes*. https://doi.org/10.1108/WHATT-07-2021-0101

Broom, D. (2020). Belgium eases lockdown with free train tickets for every citizen. In *World Economic Forum. Available online: https://www. weforum. org/agenda/2020/06/free-train-tickets-belgium-tourism-lockdowncovid-19-coronavirus/(accessed on 6 September 2020)*.

Chhabra, A., Munjal, M., Mishra, P. C., Singh, K., Das, D., Kuhar, N., & Vats, M. (2021). Medical tourism in the Covid-19 era: opportunities, challenges and the way ahead. *Worldwide Hospitality and Tourism Themes*. https://doi.org/10.1108/WHATT-05-2021-0078

Collins-Kreiner, N., & Ram, Y. (2020). National tourism strategies during the Covid-19 pandemic. *Annals of Tourism Research*. doi: 10.1016/j.annals.2020.103076

Danial, Z., Abbaspour, A., Rahimian, H., Shaarbafchi Zadeh, N., & Niknami, M. (2017). Training for medical tourism in Iran. *International Journal of Travel Medicine and Global Health*, *5*(3), 77-83. doi: 10.15171/IJTMGH.2017.17

Della Lucia, M., Dimanche, F., Giudici, E., Camargo, B. A., & Winchenbach, A. (2021). Enhancing tourism education: The contribution of humanistic management. *Humanistic Management Journal, 6*(3), 429-449. https://doi.org/10.1007/s41463-021-00111-3

Ellis, L. A., Lee, M. D., Ijaz, K., Smith, J., Braithwaite, J., & Yin, K. (2020). COVID-19 as 'Game Changer'for the physical activity and mental well-being of augmented reality game players during the pandemic: mixed methods survey study. *Journal of Medical Internet Research*, *22*(12), e25117. doi:10.2196/25117

Flaxman, S., Mishra, S., Gandy, A., Unwin, H., Coupland, H., Mellan, T. A., Zhu, H., Berah, T., Eaton, J. W., Guzman, P. N. P., Schmit, N., Cilloni, L., Ainslie, K. E. C., Baguelin, M., Blake, I., Boonyasiri, A., Boyd, O., Cattarino, L., Ciavarella, C., Cooper, L., Cucunubá, Z., Cuomo-Dannenburg, G., Dighe, A., Djaafara, B., Dorigatti, I., van Elsland, S., FitzJohn, R., Fu, H., Gaythorpe, K., Geidelberg, L., Grassly, N., Green, W., Hallett, T., Hamlet, A., Hinsley, W., Jeffrey, B., Jorgensen, D., Knock, E., Laydon, D., Nedjati-Gilani, G., Nouvellet, P., Parag, K., Siveroni, I., Thompson, H., Verity, R., Volz, E., Walters, C., Wang, H., Wang, Y., Watson, O., Winskill, P., Xi, X., Whittaker, C., Walker, P. G. T., Ghani, A., Donnelly, C. A., Riley, S., Okell, L. C., Vollmer, M. A. C., Ferguson, N. M., & Bhatt, S. (2020). Report 13: Estimating the number of infections and the impact of non-pharmaceutical interventions on COVID-19 in 11 European countries. doi: 10.25561/77731

Giudici, E., Dettori, A., & Caboni, F. (2020). Challenges of humanistic management education in the digital era. In *Virtuous Cycles in Humanistic Management* (pp. 21-35). Springer, Cham. https://doi.org/10.1007/978-3-030-29426-7_2

Gössling, S., Scott, D., & Hall, C. M. (2020). Pandemics, tourism and global change: a rapid assessment of COVID-19. *Journal of Sustainable Tourism, 29*(1), 1-20. https://doi.org/10.1080/09669582.2020.1758708.

Grech, V., Grech, P., & Fabri, S. (2020). A risk balancing act–tourism competition using health leverage in the COVID-19 era. *International Journal of Risk & Safety in Medicine, 31*(3), 121-130. DOI: 10.3233/JRS-200042

Hamid, R. A., Albahri, A. S., Alwan, J. K., Al-Qaysi, Z. T., Albahri, O. S., Zaidan, A. A., Alnoor, A., Alamoodi, A. H., & Zaidan, B. B. (2021). How smart is e-tourism? A systematic review of smart tourism recommendation system applying data management. *Computer Science Review, 39*, 100337. https://doi.org/10.1016/j.cosrev.2020.100337

Higgins-Desbiolles, F. (2020). Socialising tourism for social and ecological justice after COVID-19. *Tourism Geographies, 22*(3), 610-623. https://doi.org/10.1080/14616688.2020.1757748

Ingkadijaya, R., Desafitri, L., Djati, S. P., & Akbar, M. M. (2021). How important are training management quality and environmental conditions in influencing the effectiveness of tourism training?. *Technium Soc. Sci. J.*, *17*, 435.

Kácha, O., Kovács, B. E., McCarthy, C., Schuurmans, A. A., Dobyns, C., Haller, E., Hinrichs, S., & Ruggeri, K. (2016). An approach to establishing international quality standards for medical travel. *Frontiers in Public Health, 4*, 29. https://doi.org/10.3389/fpubh.2016.00029

Kosaka, M., Kobashi, Y., Kato, K., Okawada, M., & Tsubokura, M. (2021). Lessons from COVID-19's impact on medical tourism in Cambodia. *Public Health in Practice, 2*, 100182. https://doi.org/10.1016/j.puhip.2021.100182

Lapointe, D. (2020). Reconnecting tourism after COVID-19: The paradox of alterity in tourism areas. *Tourism Geographies, 22*(3), 633-638. https://doi.org/10.1080/14616688.2020.1762115

Liburd, J. J., Mihalič, T., & Guia, J. (2018). Values in tourism higher education: The European master in tourism management. *Journal of Hospitality, Leisure, Sport and Tourism Education, 22*, 100-104. DOI: 10.1016/j.jhlste.2017.09.003

Ma, S., Zhao, X., Gong, Y., & Wengel, Y. (2021). Proposing "healing tourism" as a post-COVID-19 tourism product. *Anatolia, 32*(1), 136-139. https://doi.org/10.1080/13032917.2020.1808490

McCartney, G. (2021). The impact of the coronavirus outbreak on Macao. From tourism lockdown to tourism recovery. *Current Issues in Tourism, 24*(19), 2683-2692. https://doi.org/10.1080/13683500.2020.1762549

Mínguez, C., Martínez-Hernández, C., & Yubero, C. (2021). Higher education and the sustainable tourism pedagogy: Are tourism students ready to lead change in the post pandemic era?. *Journal of Hospitality, Leisure, Sport & Tourism Education, 29*, 100329. https://doi.org/10.1016/j.jhlste.2021.100329

Mohanty, P. C., Dash, M., Dash, M., & Das, S. (2019). A study on factors influencing training effectiveness. *Revista Espacios*, *40*, 7-15.

Pirson, M., Vázquez-Maguirre, M., Corus, C., Steckler, E., & Wicks, A. (2019). Dignity and the process of social innovation: Lessons from social entrepreneurship and transformative services for humanistic management. *Humanistic Management Journal, 4*(2), 125-153. https://doi.org/10.1007/s41463-019-00071-9

Prideaux, B., Thompson, M., & Pabel, A. (2020). Lessons from COVID-19 can prepare global tourism for the economic transformation needed to combat climate change. *Tourism Geographies, 22*(3), 667-678. https://doi.org/10.1080/14616688.2020.1762117

Punia, B. K., & Kant, S. (2013). A review of factors affecting training effectiveness vis-à-vis managerial implications and future research directions. *International Journal of Advanced Research in Management and Social Sciences*, *2*(1), 151-164.

Qiu, R. T., Park, J., Li, S., & Song, H. (2020). Social costs of tourism during the COVID-19 pandemic. *Annals of Tourism Research, 84*, 102994. https://doi.org/10.1016/j.annals.2020.102994

Ritchie, B. W., & Jiang, Y. (2019). A review of research on tourism risk, crisis and disaster management: Launching the annals of tourism research curated collection on tourism risk, crisis and disaster management. *Annals of Tourism Research, 79*, 102812. https://doi.org/10.1016/j.annals.2019.102812

Ruggeri, K., Záliš, L., Meurice, C. R., Hilton, I., Ly, T. L., Zupan, Z., & Hinrichs, S. (2015). Evidence on global medical travel. *Bulletin of the World Health Organization*, *93*, 785-789. https://doi.org/10.2471/BLT.14.146027

Salehi-Esfahani, S., Ridderstaat, J., & Ozturk, A. B. (2021). Health tourism in a developed country with a dominant tourism market: the case of the United States' travellers to Canada. *Current Issues in Tourism, 24*(4), 536-553. https://doi.org/10.1080/13683500.2020.1724081

Santonino III, M. D. (2020). The humanistic supervisor. In *Humanistic Tourism* (pp. 166-190). Routledge.

Seo, B. R., & Kim, K. L. (2021). The Post Pandemic Revitalization Plan for the Medical Tourism Sector in South Korea: A Brief Review. *Iranian Journal of Public Health, 50*(9), 1766. doi: 10.18502/ijph.v50i9.7047

Seraphin, H. (2020). Impacts of COVID-19 on Tourism Education: Analysis and Perspectives. *Journal of Teaching in Travel and Tourism*.

Séraphin, H., & Yallop, A. (2021). *Overtourism and Tourism Education*. London: Routledge. https://lccn.loc.gov/2020026355

Sharma, A., Vishraj, B., Ahlawat, J., Mittal, T., & Mittal, M. (2020). Impact of COVID-19 outbreak over medical tourism. *IOSR Journal of Dental and Medical Sciences, 19*(5), 56-58. doi: 10.9790/0853-1905145658.

Stackpole, I., Ziemba, E., & Johnson, T. (2021). Looking around the corner: COVID-19 shocks and market dynamics in US medical tourism. *The International Journal of Health Planning and Management, 36*(5), 1407-1416. https://doi.org/10.1002/hpm.3259

Tiwari, P., Séraphin, H., & Chowdhary, N. R. (2021). Impacts of COVID-19 on tourism education: Analysis and perspectives. *Journal of Teaching in Travel & Tourism, 21*(4), 313-338. https://doi.org/10.1080/15313220.2020.1850392

Trong, N. P. N., Phi, N. T. N., Nguyen, L. T., Lan, N. M., & Thuy, P. N. T. (2021). An assessment on impacts of online education on training quality and satisfaction of tourism undergraduate students in a private university and managerial implications for educators. *International Research Journal of Management, IT and Social Sciences*, *8*(6), 534-547. https://doi.org/10.21744/irjmis.v8n6.1932

Wen, J., Kozak, M., Yang, S., & Liu, F. (2020). COVID-19: potential effects on Chinese citizens' lifestyle and travel. *Tourism Review*. https://doi.org/10.1108/TR-03-2020-0110

Yang, Y., Zhang, H., & Chen, X. (2020). Coronavirus pandemic and tourism: Dynamic stochastic general equilibrium modeling of infectious disease outbreak. *Annals of Tourism Research, 83*, 102913. doi: 10.1016/j.annals.2020.102913.

Ye, H., & Law, R. (2021). Impact of COVID-19 on hospitality and tourism education: a case study of Hong Kong. *Journal of Teaching in Travel & Tourism, 21*(4), 428-436. https://doi.org/10.1080/15313220.2021.1875967

Yin, J., Chen, Y., & Ji, Y. (2021). Effect of the event strength of the coronavirus disease (COVID-19) on potential online organic agricultural product consumption and rural health tourism opportunities. *Managerial and Decision Economics, 42*(5), 1156-1171. https://doi.org/10.1002/mde.3298

Zheng, Y., Goh, E., & Wen, J. (2020). The effects of misleading media reports about COVID-19 on Chinese tourists' mental health: a perspective article. *Anatolia, 31*(2), 337-340. https://doi.org/10.1080/13032917.2020.1747208