# Assessment of Knowledge and Awareness of Cancer Immunotherapy among Patients and Healthcare Workers in Tripoli, Libya: A Descriptive Epidemiological Study

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# تقييم المعرفة والوعي بالعلاج المناعي للسرطان بين المرضي والعاملين في مجال الرعاية الصحية في طرابلس. ليبيا " دراسة وبائية وصفية "

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## Abstract

This research aims to assess the knowledge and awareness of patients and the medical community in Tripoli-Libya about cancer immunotherapy, in addition to studying the availability of modern drugs and the challenges of their use. The questionnaire included 20 participants from different age groups and gender, and the questions focused on general knowledge of immunotherapies, drug availability, side effects of treatments, and patients' willingness to participate in clinical trials.

The findings suggest a moderate awareness of immunotherapies, with a clear recognition of the need for the medical community to enhance training and scientific research, and to improve the availability of modern drugs.

Keywords: Cancer immunotherapy, Health awareness, Medical knowledge, Patients, Healthcare workers, Tripoli – Libya, Descriptive epidemiology

**الملخص:**

يهدف هذا البحث إلى تقييم مدى معرفة ووعي المرضى والمجتمع الطبي في طرابلس-ليبيا بالعلاج المناعي للسرطان، بالإضافة إلى دراسة توفر الأدوية الحديثة وتحديات استخدامها. شمل الاستبيان 26 مشاركاً من مختلف الفئات العمرية والجنسية، وركزت الأسئلة على المعرفة العامة بالعلاجات المناعية، توافر الأدوية، الأثر الجانبي للعلاجات، ورغبة المرضى بالمشاركة في التجارب السريرية.

تشير النتائج إلى وجود وعي متوسط بالعلاجات المناعية، مع اعتراف واضح بحاجة المجتمع الطبي إلى تعزيز التدريب والبحث العلمي، وتحسين توفر الأدوية الحديثة.

**الكلمات المفتاحية:** العلاج المناعي للسرطان، الوعي الصحي ، المعرفة الطبية ، المرضى ، العاملون في القطاع الصحي طرابلس – ليبيا ،علم الأوبئة الوصفي.

**1.1 Introduction:**

Cancer treatment using pharmacological methods has evolved significantly over the past two decades, with antitumor chemotherapy targeting different stages of cell proliferation, such as DNA formation and function, as well as the mitosis spindle. Treatment is usually given intravenously in periodic doses, causing side effects such as nausea, vomiting, hair loss, as well as low blood cell counts.

Over the years, basic and clinical research has led to a major shift from the use of repeated toxic therapies to the development of anti-tumor "snipers," which target cancer cell populations more effectively and with fewer side effects. These advances include monoclonal antibodies (MABs) such as rituximab and cituximab, which target specific tumor cell antigens, such as CD20 protein in malignant lymphomas and epidermal growth factor (EGFR) receptors.In colon cancer. Bevacizumab has also been used to reduce blood supply to tumors, enhancing the effectiveness of treatments.

Shortly thereafter, tyrosine kinase inhibitors (TKIs) such as imatinib were adopted in the treatment of chronic myeloid leukemia, opening the door to a new principle in killing cancer cells by interrupting internal signals necessary for cell survival and proliferation. These inhibitors have been shown to be effective in treating multiple hematomas and solid tumors, representing a significant improvement in patient comfort.

Modern approaches to cancer treatment are considered to be those that effectively enhance the patient's autoimmune defense. These methods include bispecialty antibodies (BABs), chemeric antigen receptor T cells (CAR), and checkpoint inhibitors, which target cancer cells by activating immune responders or reducing their endurance. However, despite the benefits of these immunotherapies, they may also trigger severe inflammatory responses and autoimmune disorders.

**1.2 Search problem:**

Conventional and modern therapies in cancer treatment face a range of ongoing challenges that affect the effectiveness of treatment and the quality of life of patients. Despite significant advances in drug development, there are still major issues hindering the overall success of these treatments.

First, not all cancers respond to chemotherapy or immunotherapy, leading to treatment failure in some cases. This requires looking at alternative or new options that better meet the needs of patients. Second, conventional treatments cause serious side effects, such as nausea, hair loss, and fatigue, which negatively affect patients' quality of life and make them reluctant to complete treatment.

The problem arises of the lack of effective strategies to customize treatments based on the individual characteristics of patients and their tumors, leading to unexpected results in some cases. The high financial costs of modern treatments are also challenging, as they may not be available to all patients, limiting access to effective treatment.

Furthermore, immunotherapies can lead to severe inflammatory responses or autoimmune disorders, further complicating treatment. These issues point to the urgent need for more research to understand the exact mechanisms that influence patients' response to different treatments.

**Main question**

**1. How can the effectiveness of cancer drugs and immunotherapy be improved while reducing side effects and enhancing patients' quality of life?**

**1.3 Research Objectives:**

The research aims to analyze the effectiveness of current drugs used in cancer treatment, where the effect of chemotherapy drugs and immunotherapy on various types of cancer will be studied. The effectiveness of monoclonal antibodies and tyrosine kinase inhibitors will also be evaluated, focusing on how they affect therapeutic outcomes.

The research seeks to evaluate side effects associated with chemotherapy and immunotherapy. These effects will be identified and compared between different treatments to understand which options are safer for patients.

The research also explores the mechanisms of action of modern therapies, with the aim of understanding how these treatments affect the mechanisms of cancer cell proliferation and how to activate immune responses against them.

The research will also develop new strategies to increase the effectiveness of immunotherapy, by looking for innovative ways and using

combinations of chemotherapy and immunotherapies to improve therapeutic outcomes.

Achieving personalization of treatments is another important goal, as the research will seek to study how treatments are customized based on the genetic and biological characteristics of tumors, and evaluate the role of genetic testing in guiding treatment options.

The research will analyze the costs and benefits associated with different treatments, by estimating the financial costs and studying the clinical and economic benefits of modern treatments compared to conventional treatments.

The research seeks to assess patients' quality of life by studying the impact of treatments on their daily lives and measuring changes in side effects.

**1.4 The importance of research:**

Research into cancer drugs and immunotherapy is of outstanding importance on several levels. First, this research contributes to improved treatment outcomes, as developing new strategies can lead to increased cure rates and better patient outcomes.

Second, research plays a vital role in reducing the side effects associated with conventional treatments. By understanding the mechanisms that influence patients' response to treatment, it becomes possible to reduce these effects, enhancing patients' quality of life and making their treatment experience more tolerable.

Research helps to customize treatments based on the genetic and biological characteristics of tumors. This allocation increases the effectiveness of treatment and reduces the risks associated with inappropriate treatment.

The research also expands cancer treatment options, especially for tumors that don't respond to current treatments. This provides hope for patients who may face limited options.

The research analyzes the costs and benefits associated with different treatments, helping to improve access to effective treatments and provide health resources more efficiently.

Research advances scientific understanding about cancer and its mechanisms of action, supporting the development of new and innovative treatments. It also contributes to raising health awareness about the

importance of early detection and effective treatment, which can improve public healthcare strategies.

Through these dimensions, research into cancer drugs and immunotherapy enhances the medical community's ability to meet cancer challenges and significantly improve patients' lives.

**1.7 Research Questions:**

1. What factors affect the effectiveness of current cancer drugs?
2. How can the side effects of conventional treatments be minimized?
3. What is the role of immunotherapy in improving treatment outcomes for cancer patients?
4. How can treatments be customized based on the genetic characteristics of tumors?
5. What are the new treatment options for cancer that are not responsive to conventional treatment?
6. How can the costs and benefits of different treatments be effectively assessed?
7. What mechanisms affect patients' response to immunotherapy?
8. How can patients' quality of life be improved while receiving treatment?
9. What factors influence patients' decision to complete treatment?
10. How can awareness be raised about the importance of early detection of cancer?

**1.8 Search limits:**

**1.1.8 Geographical location:**

The research focuses on Tripoli, the capital of Libya, taking into account local factors and socio-economic contexts.

**8.2.1 Time:**

The research extends into 2025, requiring a study of current trends and future prospects in cancer treatment.

**1.3.8 Target group:**

The research focuses on cancer patients in Tripoli, examining their responses to different treatments and their challenges.

**1.4.8 Therapeutic types:**

Research includes chemotherapy and immunotherapy, focusing on their efficacy and side effects in the context of treatments available in Libya.

**1.5.8 Data and Information:**

The research draws on data available from hospitals and medical centers in Tripoli, taking into account potential limitations in data collection.

**1.9 Revision and Literature:**

**1- The study, published in the *Journal of Experimental & Clinical Cancer Research* under the title "Pharmacology-based ranking of anti-cancer drugs to guide clinical development of cancer immunotherapy combinations," examines the importance of classifying anticancer drugs based on pharmacology. This study was published on October 1, 2021.**

The study aims to improve cancer immunotherapy strategies through the development of new drugs and the rehabilitation of existing drugs, with a focus on drugs targeted for PD-1 and PD-L1. Previous research has shown that the response to immunotherapy remains modest, necessitating the need to develop combination therapies.

A total of 72 potential drugs were studied, rated based on mechanism of action, clinical efficacy, and safety. Nineteen drugs or groups of drugs evaluated in clinical trials were selected, and data on efficacy and safety from key studies were reviewed.

The study found that there is an urgent need to classify immunotherapies based on efficacy and safety, helping to guide the development of combination therapies and improve treatment strategies for a larger group of patients. A quantitative scoring methodology was also introduced that could be used as a model for classifying new treatments.

The study highlights the importance of collaboration between different drugs and the promotion of immunotherapy strategies to address cancer challenges, providing a scientific base for developing more effective treatments.

**-2Address :Cancer immunotherapy – revisited**

**Authors: W. Joost Lesterhuis، John B. A. G. Haanen، Cornelis J. A. Punt**

**Source: Nature Reviews Drug Discovery**

**Date published: 1 August 2011**

This study examines the evolution of cancer immunotherapy, focusing on the challenges that hinder its development as an effective treatment option. Although significant advances have been made in understanding immune responses against tumors, there are difficulties in determining the optimal dose, treatment schedule, and evaluation methods. Financial support is also a major obstacle.

Dosage and schedule challenges: The process of developing immunotherapy faces complications in determining optimal doses and treatment schedules.

Evaluation needs: There is an urgent need to develop tests that can effectively monitor the antitumor immune response and anticipate the response to immunotherapy.

Immune response: The dynamics of immune responses from immunotherapy differ from those caused by chemotherapy, as initial progression or new lesions may occur before the tumor shrinks.

Interaction between therapies: Recent positive results from clinical trials suggest a positive interaction between immunotherapies and chemotherapy, opening up new avenues for cancer treatment.

The study suggests that there is hope for improving the effectiveness of immunotherapy thanks to positive results from clinical trials with new drugs, which could pave the way for a new era in cancer treatment.

The study emphasizes the importance of addressing current challenges in the development of immunotherapy, and highlights the need for continuous research to understand the dynamics of the immune response .and the interaction between different therapies

**3-Address :Immunotherapy of cancer: a review of the current status and future directions**

**source: Clinical & Experimental Allergy**

This study examines the case of cancer immunotherapy, highlighting the progress made so far and the challenges that remain. The study examines different uses of immunotherapy, including vaccines and antibody therapy, and reviews the clinical outcomes of current treatments.

Current advances: Significant progress has been made in understanding how to stimulate the immune system to fight cancer, leading to the development of several treatment strategies.

Clinical challenges: Challenges include evaluating the effectiveness of immunotherapies, as more research is still needed to better understand the mechanisms of the immune response.

Future directions: The study suggests that new ways to enhance the immune response and improve clinical outcomes are needed, including the integration of immunotherapies with conventional therapies.

The study highlights the importance of immunotherapy as a cancer treatment option, while emphasizing the need for more research to understand the complex dynamics of the immune response and the .interaction between different treatments

**-4Address :New drugs, new toxicities: severe side effects of modern targeted and immunotherapy of cancer and their management**

**Authors: Frank Kroschinsky، Friedrich Stölzel، Simone von Bonin، Gernot Beutel، Matthias Kochanek، Michael Kiehl، Peter Schellongowski**

**Source: Critical Care**

**Date published: 14 April 2017**

This study examines significant changes in cancer treatment using targeted therapies and immunotherapy, focusing on new side effects that may be severe. While these treatments have improved satisfactory outcomes and comfort for patients, they have also brought with them new patterns of toxicity.

Changing nature of treatments: Modern treatments represent a shift from conventional chemotherapy, targeting cancer cells more precisely, leading to less severe side effects in most cases.

Serious side effects: Although most side effects are mild, some patients experience severe complications that require admission to the intensive care unit.

Cytokine secretion syndrome (CRS): CRS is a major side effect, causing a severe inflammatory response that leads to symptoms such as fever, low blood pressure, and laboratory disorders.

Neurological effects: Some therapies such as bidirectional antibodies (BABs) and CAR T cell therapy may lead to neurotoxicity, including deterioration of consciousness and seizures.

Immune-related adverse events: Immune-related side effects include gastrointestinal infections and endocrine disorders, which may require treatment in the intensive care unit.

The study highlights the need to develop effective strategies to manage complications resulting from modern cancer treatments. She also points out the importance of collaboration between different healthcare teams to ensure that patients with these treatments are provided with the best .possible care

**-5Address :Delivery technologies for cancer immunotherapy**
**Authors: Rachel S. Riley، Carl H. June، Robert Langer، Michael J. Mitchell**
**Source: Nature Reviews Drug Discovery**
**Date published: 8 January 2019**

This study examines the delivery techniques of immunotherapy for cancer, which have become a powerful clinical strategy in cancer treatment. Immunotherapies represent a big step in improving patient outcomes, but major challenges remain, such as controlling the immune system response and avoiding serious side effects.

Delivery challenges: Modern drug delivery technologies, such as nanoproteins and cell-based systems, are effective tools to increase the response of immunotherapies and reduce negative side effects.

Improving the response: Improving the response of immunotherapy requires a deep understanding of biological mechanisms, contributing to the development of more effective delivery systems.

New technologies: The study focuses on advanced technologies, such as the use of biomaterials and drug delivery systems, that can enhance the effectiveness of immunotherapies.

Future challenges: The study examines the opportunities and challenges related to the integration of delivery technologies into cancer immunotherapies and provides a critical analysis of future prospects in this field.

The study suggests that effectively delivering immunotherapies can improve treatment outcomes and reduce side effects. Ongoing research needs to improve these techniques and develop new strategies to support the effectiveness of immunotherapies in treating cancer.

**Definition of Terms**

**1. Cancer immunotherapy**

It is a type of therapy that uses the body's immune system to fight cancer, by boosting or redirecting the immune response against cancer cells.

**2. Biochemistry**

A branch of science that studies chemical reactions and biological processes in living organisms, including drug and antigen interactions.

**3. Monoclonal antibodies**

These are proteins made in a laboratory that target and attach to specific antigens on the surface of cancer cells, which helps the immune system recognize and destroy them.

**4. Tyrosine kinase inhibitors**
Drugs that target specific enzymes that play a role in cell growth signals, which inhibit the growth of cancer cells.
**5. Immune response**
It is the way the immune system reacts to pathogens such as viruses, bacteria, and cancer cells.
**6. Clinical Trials**
Studies in humans to evaluate the effectiveness and safety of new drugs or treatments, divided into multiple phases.
**7. Side Effects**
Unwanted reactions that occur as a result of treatment, which may include symptoms such as nausea, fatigue, or rashes.
**8. Medical Customization**
A method that relies on an individual's characteristics, such as genetic makeup or biological characteristics, to determine the best treatment options.
**9. Targeted Drugs**
Drugs designed to target specific properties in cancer cells, reducing damage to healthy cells.
**10. Health Awareness**
Individuals and communities understand the concepts of health and disease, and the importance of prevention and treatment, which influences their health decisions.
**11. Combination Treatments**
Therapeutic strategies that combine several medications or therapeutic methods to increase effectiveness and reduce side effects.
**12. Genetics**
Genetic factors that are passed down from parents to children may play a role in determining cancer risk.
**13. Health Education**
Efforts to provide individuals and communities with the information needed to improve their health and safety.
**14. Modern Medicines**
Refers to recently developed drugs that are based on new scientific research, including immunotherapies and targeted therapies.
**15. Quantitative Modeling**
A method used to perform numerical assessments and analyses to predict treatment outcomes or medication effectiveness.
**2.1 Introduction to Immune Cancer**
Immune cancer is a term used to describe certain types of cancer that interfere with or result from a malfunction in the body's immune system.

The immune system, which consists of a complex network of cells, tissues, and organs, has the primary task of defending the body against foreign bodies, such as bacteria, viruses, and abnormal cellular mutations. In a normal state, the immune system has an amazing ability to distinguish between normal body cells and foreign or infected cells. However, certain conditions can lead to This ability is disrupted, allowing cancer cells to evade immune control and growth in an uncontrollable manner.(1)

In some cases, the immune system can contribute to the development of cancer rather than fighting it. For example, chronic inflammation caused by an extended immune response may create a favorable environment for tumor growth. On the other hand, cancer cells may exploit some of their natural immune regulation mechanisms to suppress the immune response against them, helping them survive and spread within the body." (2)

Scientific interest in linking the immune system to cancer began in the early twentieth century, but the real breakthrough in this field has occurred in recent decades as our understanding of the role of "immune checkpoints" and regulatory proteins such as PD-1 and CTLA-4 has evolved. The discovery of these mechanisms prompted researchers to develop new therapeutic approaches focused on reactivating the immune system to attack cancer, leading to what is known today as "cancer immunotherapy."(3)

Immunotherapy has become a key pillar of cancer control strategies alongside chemotherapy, radiation, and surgery. Clinical trials have shown that some cancers, such as advanced melanoma and non-small cell lung cancer, respond wonderfully to immunotherapy, resulting in significantly improved survival rates."(4)

However, immune cancer remains a complex challenge. Some patients may not respond to immunotherapy, while others may experience serious immune side effects. Therefore, research is currently moving towards improving the effectiveness of immune drugs and reducing their side effects through a deeper understanding of the complex interactions between the tumor and the immune system. (5)

Developing an effective treatment for immune cancer requires a thorough understanding of how tumors originate, how cancer cells interact with the immune system, and the mechanisms they use to evade

the immune response. In this context, molecular biology, immunology and oncology research plays an essential role in shedding light on these vital processes.

In conclusion, autoimmune cancer is a highly developed field of cancer research. Immunotherapy is a glimmer of hope for thousands of patients around the world and reflects the ability of modern medicine to harness the body's natural powers to fight the deadliest diseases. With continuous advances in biotechnology, the field is expected to see new innovations that will revolutionize the way cancer is treated in the coming years." (6)

**2.2 Types of drugs used**

With tremendous scientific advances in understanding the interactions of the immune system with cancerous tumors, a variety of drugs have evolved that aim to improve the effectiveness of the immune system in fighting cancer or work to destroy cancer cells directly or indirectly. Drugs used in the treatment of immune cancer can be classified into two main categories: immunomodulatory drugs, which enhance or modulate the immune system response, and targeted therapies, which focus on disrupting the specific vital processes on which cancer cells depend for growth and survival(7)

One of the most important advantages of immunomodulators is that they do not always attack cancer cells directly, but rather activate the immune system's inert or weakened abilities against the tumor. These drugs represent a real therapeutic revolution, especially with the discovery of immune checkpoints such as PD-1 (Programmed cell death protein 1) and CTLA-4 (Cytotoxic T-Lymphocyte Antigen 4), molecules found on the surface of immune cells and act as keys to inhibit their activity to prevent excessive inflammation. However, some cancer cells exploit these pathways to escape from Immune response. Thus, the inactivation of these switches via checkpoint inhibitor drugs reactivates immune cells and enables them to recognize and destroy tumors."(8)

Targeted therapies are based on a detailed understanding of the molecular or biochemical characteristics of tumors. These treatments target specific proteins or cellular signaling pathways necessary for cancer cells to survive. For example, some tumors rely excessively on the formation of new blood vessels to feed them with oxygen and nutrients, a process known as angiogenesis. Medications such as VEGF inhibitors (Vascular

Endothelial Growth Factor) This process is hindered, starving the tumor and preventing its growth]

These types of drugs offer wide possibilities in treating cancers whose conventional treatment has been difficult or limited in effectiveness. For example, in non-small cell lung cancers (NSCLC) and metastatic melanoma, PD-1/PD-L1 inhibitors have shown significant improvement in survival rates. Cell division inhibitors, such as CDK4/6 protein inhibitors, have been shown to be particularly effective in hormone-receptor-positive breast cancers

Despite these successes, important challenges remain. Patients' response to these treatments may vary widely, and resistance to treatment can evolve over time. This prompted researchers to develop therapeutic strategies that combine different types of drugs, such as combining checkpoint inhibitors with vascular growth inhibitors or with conventional therapies such as chemotherapy or radiation.(9)

In this context, new approaches such as adaptive cell therapies have also emerged, most notably genetically modified T cell therapy, where the cells of a patient's immune system are genetically modified to target cancer cells more efficiently. These treatments have seen great success in some types of blood cancers such as acute lymphocytic leukemia and malignant lymphomas(10)

In light of this diversity, choosing the right treatment depends on several factors including the type of cancer, the molecular characteristics of the tumors, the patient's general condition, and the response of their immune system. This makes personalized medicine, or personalized treatment depending on their condition, a prominent trend in modern cancer treatment.

**2.2.1 Immunomodulatory drugs**

Immunomodulatory drugs are the cornerstone of the treatment of many immune-dependent cancers. This class of therapies is based on enhancing the patient's immune system's ability to recognize and kill cancer cells. Immunocheckpoint inhibitors are one of the most prominent innovations in this field, as they disrupt the mechanisms used by cancer cells to escape immune system control.

Among the most famous of these inhibitors are drugs that target PD-1 (Programmed Death-1) or PD-L1 (Programmed Death Ligand-1). Commonly found on the surface of immune cells and cancer cells, these

proteins inhibit the activity of T-cells when they bind together, preventing the immune system from attacking the tumor. By inhibiting these proteins via drugs such as nivolumab and pembrolizumab (Pembrolizumab), can restore the activity of immune cells against tumors.

In contrast, Ipilimumab targets another protein called CTLA-4 (Cytotoxic T-Lymphocyte Associated protein 4), which plays a key role in controlling the onset of a T cell response. Disabling CTLA-4 can lead to enhanced activation of immune cells to attack tumors more strongly. Clinical studies suggest that the combination of PD-1 inhibitors CTLA-4 can significantly enhance the effectiveness of treatment in some patients, although this may be associated with an increased risk of immune side effects.

Immune-stimulating drugs, on the other hand, include agents such as interleukin-2 (IL-2) and interferon-alpha (IFN-α), which activate and increase immune cell populations such as T cells and NK cells, boosting the immune response against the tumor. Although these treatments have been in use for decades, their relatively severe side effects and newer alternatives have significantly limited their use."(11)

The role of cancer vaccines, which seek to train the immune system to recognize antigens specific to cancer cells, cannot be overlooked. An example is the Sipuleucel-T vaccine used to treat castration-resistant prostate cancer. Despite the challenges associated with producing effective vaccines against tumors, this area is still under development and holds promise."

In general, immunomodulatory drugs represent a paradigm shift in oncology, as they not only directly target the tumor, but also stimulate the immune system to act against cancer cells in a sustainable way, increasing the chances of achieving lasting responses.

**2.2.2 Targeted therapies**

Targeted therapies represent a major advance in cancer treatment, as they differ fundamentally from conventional chemotherapy therapies that target all rapidly dividing cells, whether cancerous or healthy. In contrast, targeted therapies are designed to attack specific molecular characteristics or biological pathways involved in cancer cell growth and survival."

One of the main strategies for targeted therapies involves angiogenesis inhibitors. Tumors rely on the growth of a network of new blood vessels

to provide oxygen and nutrients for their growth, a process known as angiogenesis. One of the most important drugs in this area is Bevacizumab, a monoclonal antibody that targets vascular endothelial growth factor (VEGF). Prevent VEGF from binding to its receptor, bevacizumab contributes to reducing the blood supply of the tumor, which leads to starvation and slowing its growth.

Another important category is cell cycle inhibitors, which target proteins and pathways responsible for controlling the cell's life cycle. An example is CDK4/6 inhibitors such as Palbociclib, which block the progression of cancer cells from growth to division, effectively slowing their replication

In addition, there are inhibitors of kinase proteins such as Imatinib, which target BCR-ABL genetic changes in chronic myeloid leukemia

Studies have shown that targeted therapy may provide significant benefits in terms of improving response rates and reducing side effects compared to conventional chemotherapy. But the emergence of resistance to these drugs is a real challenge. The development of cancer cells for mechanisms that circumvent treatment, such as secondary mutations or activation of alternative pathways of growth, is constantly pushing researchers to develop new generations of drugs or combine more than one targeted therapy to increase effectiveness

In addition to targeted chemotherapy, drugs based on antibody-drug conjugates technology are being develope, in which a toxic drug is attached to an antibody that targets a specific antigen on the surface of cancer cells, allowing the treatment to be accurately delivered to the tumor while minimizing damage to healthy tissue."

In general , targeted therapies offer enormous potential for more accurate and effective cancer treatment and are one of the cornerstones of modern therapy along with immunotherapies.

**2.3 The mechanism of action of drugs**

Immunocyton cancer drugs have complex and precise mechanisms of action aimed at correcting or stimulating the immune system's response against cancer cells. The main mechanisms of action can be classified into two parts: immunosuppressants and targeted therapie.

**2.3.1 Checkpoint inhibitor mechanism**

Checkpoint inhibitors represent a breakthrough in immunological oncology. To understand how they work, you must first understand immune checkpoints. They are

proteins found on the surface of T-cells that act as switches on and off for immune system responses. These proteins help maintain a balance between fighting infection and preventing autoimmune responses.

One of the most important of these proteins is PD-1 (Programmed Death-1) and its counterpart PD-L1 (Programmed Death Ligand-1). When PD-1 interacts with PD-L1 on cancer cells, a signal is sent to the T cell to inhibit its activity, allowing the cancer to escape the immune response(12).

Checkpoint inhibitor drugs such as nivolumab and pembrolizumab work by blocking this reaction, reactivating T cells and pushing them to actively attack the tumor.

Another important protein is CTLA-4 (Cytotoxic T-Lymphocyte-Associated Protein 4), which inhibits T cells when binding to B7 molecules on antigen-presenting cells. Drugs such as Ipilimumab target CTLA-4, which leads to enhanced activity of T cells and increased ability to attack tumors(13).

These treatments have been shown to be effective in multiple types of cancers such as melanoma, non-small cell lung cancer, and some types of kidney and bladder cancers.

However, boosting the immune system can sometimes lead to excessive immune reactions such as colitis, pneumonia, or liver and thyroid problems, requiring careful monitoring during treatment.

2.3.2 Mechanism of targeted therapies

Targeted therapies rely on identifying specific mutations or biomolecules that are essential for tumor growth or survival. Thanks to advances in molecular genetics, it is possible to design drugs that recognize and target these characteristics directly.

A prominent example is human growth factor 2 (HER2) receptor inhibitors in breast cancer. Trastuzumab is a monoclonal antibody that binds to the HER2 protein , blocking growth signals and inducing the immune system to attack cancer cells through a phenomenon known as antibody-mediated cytotoxicity (ADCC).

Also, there are drugs that target mutations in the BRAF gene in melanoma, such as vemurafenib, which selectively inhibits the mutated BRAF protein, significantly shrinking tumors

Targeted therapies also rely on inhibitors of kinase proteins, enzymes involved in signaling that stimulate cell growth. For example, Erlotinib

and Gefitinib target EGFR receptors that are mutated in some lung cancers.

Although these treatments have proven effective, the problem of developing tumor resistance is a major challenge. Therefore, drug combinations are being developed that combine multiple inhibitors to reduce the chances of the emergence of resistance

**2.4 Clinical trials**

Clinical trials are the backbone for evaluating the efficacy and safety of drugs used in the treatment of immune cancer. Through these studies, new treatments, whether immunosuppressant drugs or targeted therapies, are tested on different groups of patients to see how well they can improve survival and reduce tumor size.

**2.4.1 Definition of clinical trials**

Clinical trials are research studies conducted in humans with the aim of evaluating new medical interventions. They are usually divided into four stages:

- Phase I: focuses on assessing safety and appropriate dosage.
- Phase II: Evaluate the event and continue with security monitoring.
- Stage III: Compares new treatment with conventional treatment.
- Phase IV: Conducted after approval to monitor long-term effects.

These studies are very carefully designed and supervised by independent bodies to ensure the protection of patients' rights.

**2.4.2 Landmark clinical trials on immunomodulatory drugs**

Try CheckMate 017 and CheckMate 057

These two randomized trials were pivotal in the adoption of Nivolumab for the treatment of non-small cell lung cancer. The results showed that patients who received nivolumab had higher survival rates compared to patients who received conventional chemotherapy with Docetaxel.

Results:

One-year survival rate: 42% with nivolumab versus 24% with chemotherapy.

Significant improvement in quality of life and reduced side effects.

KEYNOTE-001 EXPERIENCE

This study tested Pembrolizumab on patients with multiple types of cancer, including melanoma and lung cancer. It showed that a large percentage of patients responded positively to treatment.

**Results:**

Overall response rate: 19.4% in all patients, 45.2% in patients who showed high levels of PD-L1.

IMvigor210 experience

This trial focused on the drug atezolizumab for the treatment of advanced bladder cancer. It has shown that patients with high levels of PD-L1 on tumor-bound immune cells had a higher response to treatment.

Results:

The median survival rate improved to 11.4 months compared to previous outcomes of only 8 months in this cancer class.

**2.4.3 The importance of biomarkers**

These trials have shown the importance of biomarkers such as the level of expression of PD-L1 as a key determinant for selecting patients who will benefit the most from immunotherapy. Analysis of these indicators has become an essential part before starting treatmen

However, not all cancers rely entirely on PD-L1 as an indicator, making it necessary to develop additional biological markers in the future.

**2.4.4 Challenges in clinical trials**

Despite successes, clinical trials face several challenges, including:

Difficulty identifying suitable patients for treatment.

Resistance to treatment develops over time.

Management of new and unexpected immune side effects.

High long costs of trials and drugs.

**2.4.5 The role of future experiments**

Currently, several trials seek to combine checkpoint inhibitors with other treatments such as chemotherapy, radiation therapy, or targeted therapies to increase effectiveness and overcome resistance. New drugs targeting alternative immune pathways such as LAG-3 and TIGIT are also being explored.

**2.5 Side effects**

Drugs for the treatment of immune cancer, especially immunosuppressants and targeted therapies, although highly effective, are associated with a wide range of side effects that require careful and careful management These symptoms differ from those associated with conventional chemotherapy, as they are often caused by an overactive immune system against healthy body tissue

**2.5.1 Nature of side effects**

Autoimmune reactions (Immune-Related Adverse Events, irAEs):

They occur as a result of the immune system targeting normal body cells and tissues, and can affect any organ or vital system.

Duration of symptom onset:

Symptoms may appear within weeks of starting treatment or even months after it ends.

Severity:

Ranging from mild symptoms to serious complications that may be life-threatening if rapid intervention is not done.

### 2.5.2 The most important side effects by devices

| Infected organ | Common symptoms | Reviews |
|---|---|---|
| Skin | Rash, itching, pigmentation | The most common, they are usually mild. |
| Intestinal | Diarrhea, colitis | It may lead to intestinal perforations if not treated early. |
| Lung | Immune pneumonia | It may be life-threatening and requires stopping treatment. |
| Endocrine | Adnexitis, cortisol deficiency | It leads to disruption of hormones and requires hormone replacement therapy. |
| Liver | Hepatitis immunity | It usually appears with elevated liver enzymes. |
| Kidney | Immune nephritis | It causes impaired kidney function. |
| Nervous system | Neuropathy, neuropathy | Rare but very dangerous. |

### 2.5.3 Management of side effects

Effective management of side effects depends on three main principles:

Early diagnosis :

The medical team should be highly aware of the warning symptoms and train patients to report any new symptoms immediately.

Early intervention:

When an immune side effect is suspected, treatment is temporarily or permanently discontinued depending on the severity of the condition, and immunosuppressive treatment is initiated, often with corticosteroids.

Continuous monitoring :

Some cases require periodic monitoring of organ functions even after the end of treatment.

For example, in the case of immunotherapy-induced colitis, oral or intravenous cortisone should be started quickly, and if the patient does not improve, additional inhibitory drugs such as infliximab are used.

### 2.5.4 Comparison of side effects with chemotherapy

| Side | Immunotherapy | Chemotherapy |
|---|---|---|
| Nature of symptoms | Immunomodulatory (autonomic) | Direct toxicity to healthy cells |
| Prevalence of hair loss | Less common | More common |
| Blood disorders | Less common | Very common (low blood cells, bleeding) |
| The need to stop treatment | May be necessary early in severe immune conditions | Treatment is usually supplemented with dose reduction |

### 2.5.5 The importance of education and awareness of symptoms

Continuous patient education about early recognition of side effects is a critical factor in improving treatment outcomes and minimizing complications. Patients should be advised not to ignore any new changes such as rashes, shortness of breath, or changes in weight or mood.

## 2.6 Future

Immunotherapeutics are one of the fastest evolving fields in modern medicine, with huge expectations that they will revolutionize cancer care over the coming decades. As research progresses, scientific efforts are geared towards improving the effectiveness of these treatments, expanding their use, and reducing their side effects, in order to achieve better treatment outcomes and a higher quality of life for patients.

### 2.6.1 Future research directions

Design of gene-mutation-specific therapies: Develop targeted immunotherapies that recognize mutations specific to each cancerous tumor, increasing treatment accuracy and minimizing side effects.

Enhancing the effectiveness of combined therapy: combining immunotherapies with chemotherapy, radiation or targeted molecular therapies with the aim of enhancing the effectiveness of the elimination of cancer cells.

Targeting new immune checkpoints: Ongoing research is moving towards discovering additional molecules on immune cells that could be

targeted, such as LAG-3, TIM-3, and TIGIT, which could open up new treatment options.

Genetically modified immune cell therapy (CAR-T Cells): Although this technique has proven successful in some types of blood cancers, research is ongoing to expand its use against solid tumors.

Immunovaccine therapy: Customized vaccines are being developed that specifically target cancer cells, to stimulate the immune system more effectively.

**2.6.2 Future challenges**

Despite high hopes, progress faces several key challenges:

Tumor resistance to immunotherapy: Some cancers develop mechanisms to escape immune control, which calls for the development of new strategies to overcome this resistance.

High treatment cost: Modern immunotherapies are expensive, posing challenges in making them available to all, especially in low-income countries.

Chronic side effects management : As cancer survivors grow, long-term follow-up plans are needed to monitor and treat immune symptoms that may appear long after treatment ends.

Lack of predictive biomarkers: There is a need to develop accurate biomarkers that help identify patients who benefit most from immunotherapies.

**2.6.3 Future outlook**

Many studies predict that immunotherapy over the next decade will become:

First-line treatment for many cancers, rather than conventional chemotherapy.

More personalized based on the analysis of the genetic and immune features of the individual.

Less toxic and more able to achieve long-lasting healing.

Relying more on artificial intelligence to analyze patient data and design optimal treatment protocols

**2.1 Introduction**

The choice of materials and methods is an essential part of any research study, as the tools and techniques used to collect and analyze data are identified. In this chapter, we will review in detail the materials and tools used in the study, as well as the steps involved in data collection and analysis in Tripoli, Libya.

Tripoli is a pivotal city in Libya in terms of infrastructure, academic and medical developments, making it an ideal place to carry out studies related to multiple fields. In this context, we will provide details on how

to choose materials and tools that fit the objectives of the study, and methods of data collection that are in line with local requirements.

## 2.2 Materials

### 2.2.1 Target community

The materials are represented by individuals selected within the target community in Tripoli. This depends on specific criteria such as age, health status, social background, or the sector in question. For example, if the study is related to the field of medicine, patients with certain diseases (such as cancer or heart disease) may be selected in Tripoli hospitals or medical clinics.

In studies related to public health, it is possible to select samples of individuals from different geographical areas within Tripoli, to cover diverse groups representing the local community.

### 2.2.2 Tools and techniques

A variety of tools are used to collect data in the study, and these include:

Questionnaires and interviews: Targeted questionnaires are designed to collect accurate information from participants. Face-to-face or online interviews are used for those who prefer this type of participation.

Laboratory analysis: If the study is health-related, laboratory medical tests such as blood tests, X-rays, or other diagnostic tests will be performed.

Digital technologies: Data analysis software (such as SPSS or Excel) was used to analyze responses, and analyze statistics to provide interpretable results.

Special software: If the study is related to geography or spatial data analysis, programs such as ArcMap and GIS were used to analyze geographic data (especially in city studies).

## 2.3 Methods

### 2.3.1 Research design

A descriptive or experimental research design was used, depending on the nature of the topic under study. In medical studies, research may be based on comparing results between a sick and healthy group (pilot study). In social or economic studies, descriptive research has been used to study the factors affecting some phenomena within the community.

### 2.3.2 Data collection

Interviews: Interviews were conducted with patients and doctors in hospitals, or with individuals working in the institutions concerned (depending on the subject of the study). The interviews were conducted using approved questionnaires to identify influencing factors or to examine specific hypotheses.

Social surveys: Pre-prepared questionnaires distributed to study participants were used to obtain sufficient responses to present the results. Documentary analysis: If the study is related to laws or policies, various documentary sources such as official reports, previous studies, and open databases were used to obtain comprehensive information.

### 2.3.3 Data analysis

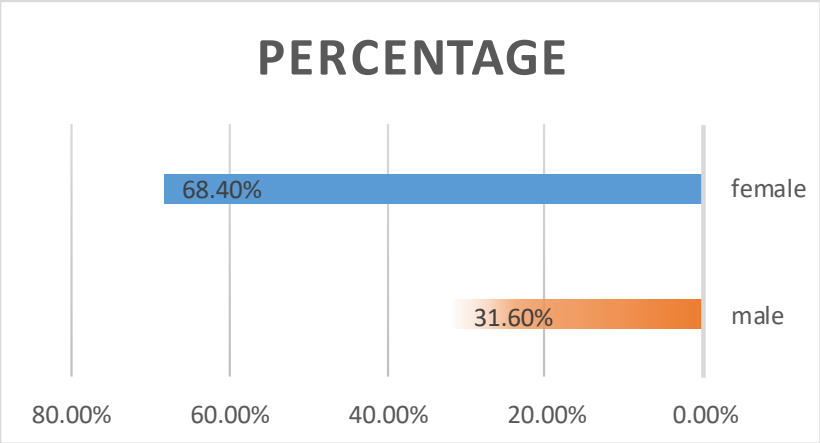
Statistical software (such as SPSS, or other analytical software) was used to analyze the results collected. Analysis includes a statistical analysis of the collected data to extract important patterns and trends.

Qualitative analysis: For studies based on interviews or field observations, subject analysis was used to extract key patterns in the data.

**Analysis of the results of the questionnaire**

**Table 1: Distribution of sample by type**

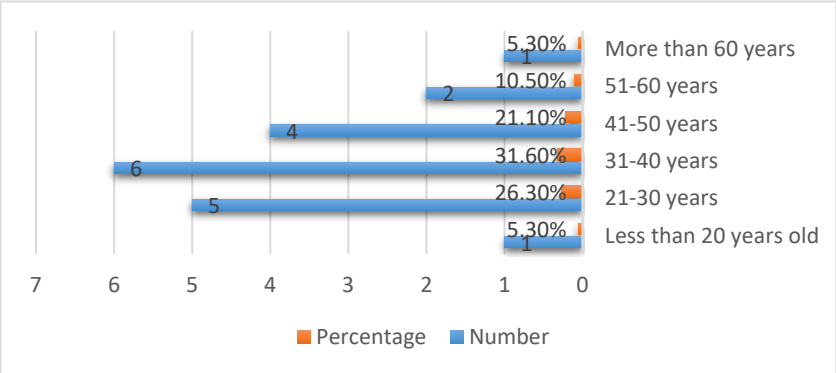
| genre | Number | Percentage |
|---|---|---|
| male | 6 | 31.6% |
| female | 13 | 68.4% |




**Commentary:** Data indicate that the majority of study participants are female, at 68.4%, which may be due to higher rates of diagnosis of certain types of cancer (such as breast cancer) in women compared to men, or to more female involvement in health questionnaires.

**Table 2: Distribution of sample by age**

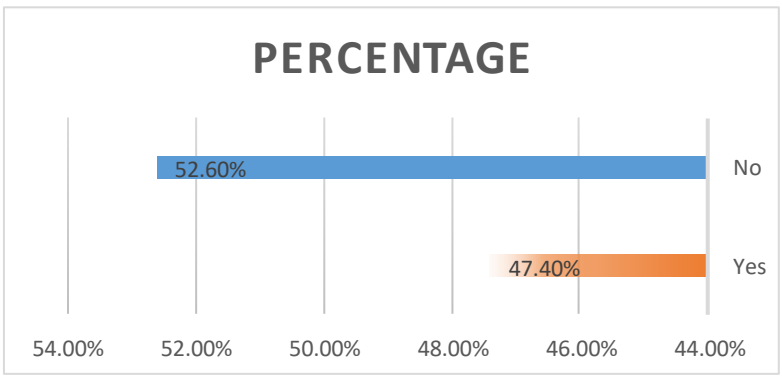
| Age Group | Number | Percentage |
|---|---|---|
| Less than 20 years old | 1 | 5.3% |
| 21-30 years | 5 | 26.3% |
| 31-40 years | 6 | 31.6% |
| 41-50 years | 4 | 21.1% |
| 51-60 years | 2 | 10.5% |
| More than 60 years | 1 | 5.3% |




**Commentary** The majority of the sample is concentrated in the age groups between 21 to 50 years, which are the most active age groups in society, and some types of cancer begin to appear at these ages, which justifies the distribution of cases.

**Table 3: Family history of cancer**

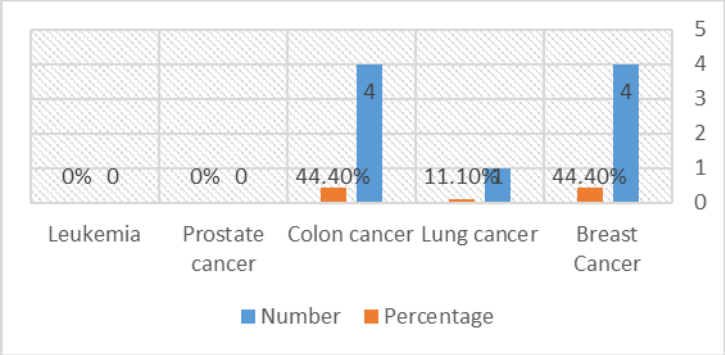
| Having a family history | Number | Percentage |
|---|---|---|
| Yes | 9 | 47.4% |
| No | 10 | 52.6% |



**Commentary:** **The** results show that about half of the participants have a family history of cancer, which supports the hypothesis of the influence of genetic factors on cancer, which is consistent with what has been scientifically proven in several recent studies.

**Table 4: Type of diagnosed cancer**

| Type of cancer | Number | Percentage |
|---|---|---|
| **Breast Cancer** | 4 | 44.4% |
| **Lung cancer** | 1 | 11.1% |
| **Colon cancer** | 4 | 44.4% |
| **Prostate cancer** | 0 | 0% |
| **Leukemia** | 0 | 0% |

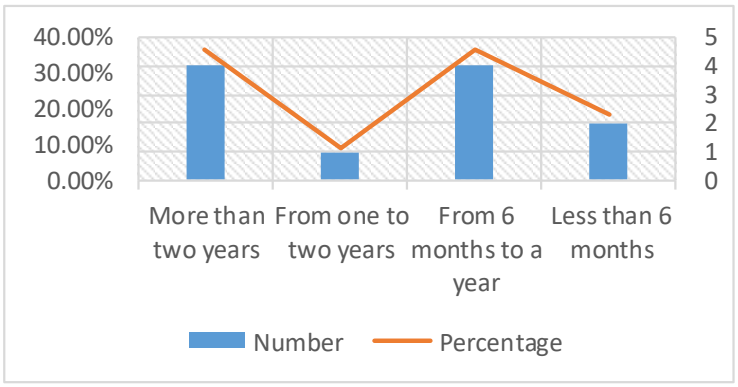



**Commentary:**

The most diagnosed types of cancer among the sample are breast cancer and colon cancer, with an equal percentage (44.4%). This is in line with global statistics that show high rates of infection of these two types, especially with the development of screening and early diagnosis tools.

**Table 5: Duration of cancer diagnosis**

| Duration of diagnosis | Number | Percentage |
|---|---|---|
| Less than 6 months | 2 | 18.2% |
| From 6 months to a year | 4 | 36.4% |
| From one to two years | 1 | 9.1% |
| More than two years | 4 | 36.4% |

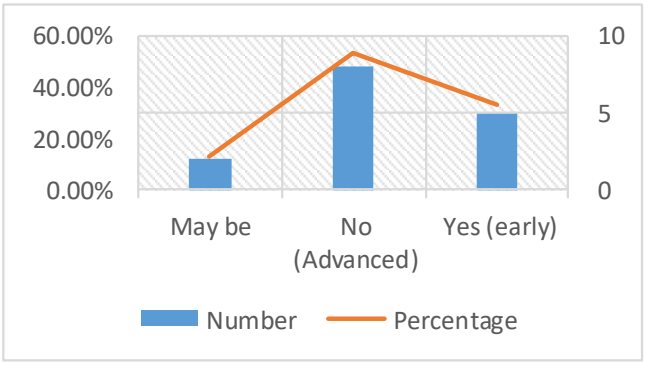



**Commentary:**

The results indicate that 72.8% of patients were diagnosed more than 6 months ago, indicating that most cases are not newly discovered and may have gone through advanced therapeutic stages, making understanding the stages of the disease and responding to different treatments critical.

**Table 6: Stage of cancer diagnosis (early or advanced)**

| Stage | Number | Percentage |
|---|---|---|
| **Yes (early)** | 5 | 33.3% |
| **No (Advanced)** | 8 | 53.3% |
| **May be** | 2 | 13.3% |

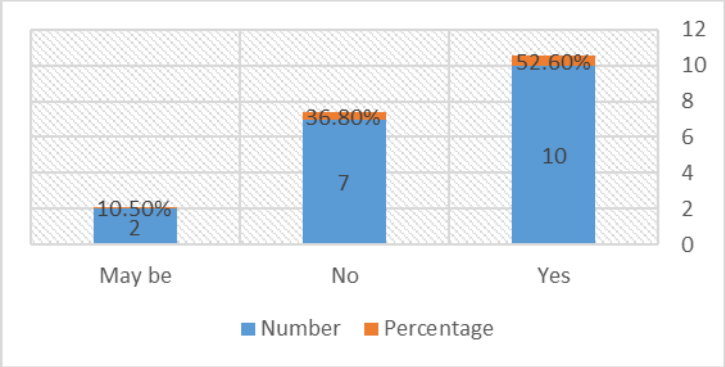



**Commentary:**

The majority of cases have been detected at an advanced stage (53.3%), reflecting an urgent need for early detection and health awareness programs in Tripoli to enhance treatment opportunities and improve survival rates.

**Table 7: Participants' Knowledge of Cancer Immunotherapy**

| Knowledge of immunotherapy | Number | Percentage |
|---|---|---|
| **Yes** | 10 | 52.6% |
| **No** | 7 | 36.8% |
| **May be** | 2 | 10.5% |

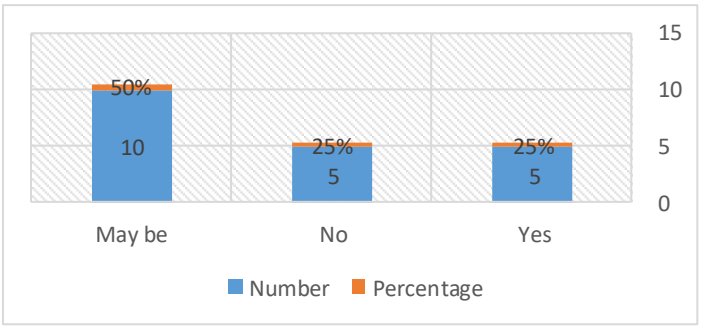



**Commentary:**

More than half of the participants have knowledge of immunotherapy, indicating a relative improvement in the awareness of the medical and community community about modern treatment options, with a gap that needs to be filled through specialized education campaigns.

**Table 8: Effectiveness of oral cancer drugs compared to conventional treatments**

| Opinion about oral medications | Number | Percentage |
|---|---|---|
| **Yes** | 5 | 25% |
| **No** | 5 | 25% |
| **May be** | 10 | 50% |

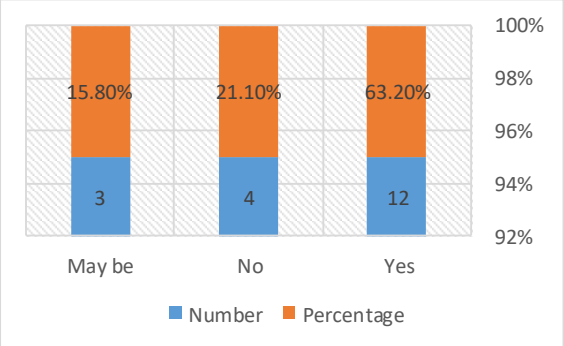


**Commentary:**

Data show that half of the sample is unsure about the effectiveness of oral medications compared to conventional treatments, reflecting a lack of information or clinical experience about these treatment options, with more clinical studies needed to support the treatment decision.

**Table 9: Participants' knowledge of different types of immunotherapy**

| Knowledge of types of immunotherapy | Number | Percentage |
|---|---|---|
| **Yes** | 12 | 63.2% |
| **No** | 4 | 21.1% |
| **May be** | 3 | 15.8% |

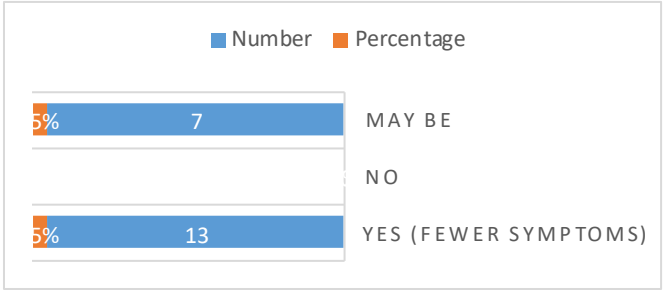



**Commentary:**

The results indicate that a good percentage (63.2%) of the sample have knowledge of the types of immunotherapies, such as T cell therapy and antibodies, which indicates the spread of specialized knowledge among the group of medical learners and practitioners.

**Table 10: Evaluation of immunotherapy side effects compared to chemotherapy**

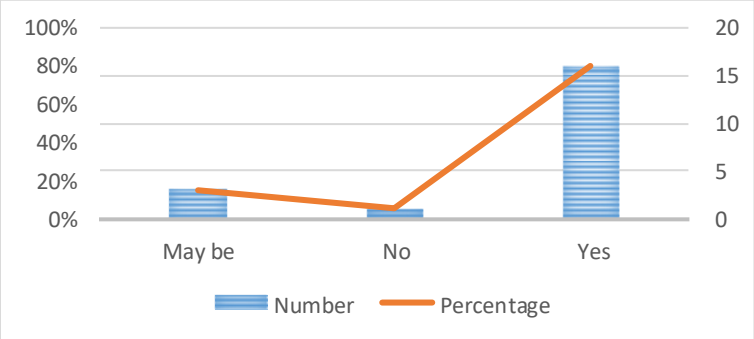
| Opinion about side effects | Number | Percentage |
|---|---|---|
| **Yes (fewer symptoms)** | 13 | 65% |
| **No** | 0 | 0% |
| **May be** | 7 | 35% |



**Most** participants believe that immunotherapy has fewer side effects compared to chemotherapy, which is in line with recent studies suggesting that immunotherapies are usually better tolerated in patients, though not completely risk-free.

**Table 11: Availability of cancer drugs to the patient in Tripoli**

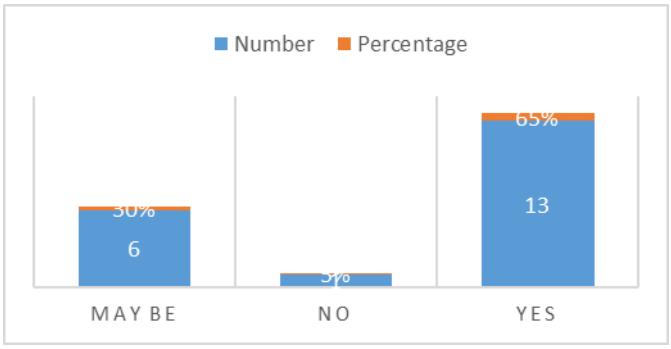
| Opinion on the availability of medicines | Number | Percentage |
|---|---|---|
| **Yes** | 16 | 80% |
| **No** | 1 | 5% |
| **May be** | 3 | 15% |




**Commentary:**
Findings indicate that 80% of respondents believe that cancer drugs should be more available in Tripoli. This reflects real challenges in the provision of treatments, which require strengthening health policies and expanding drug supply capacities in Libya.

**Table 12: Belief in immunotherapy as a future treatment option**

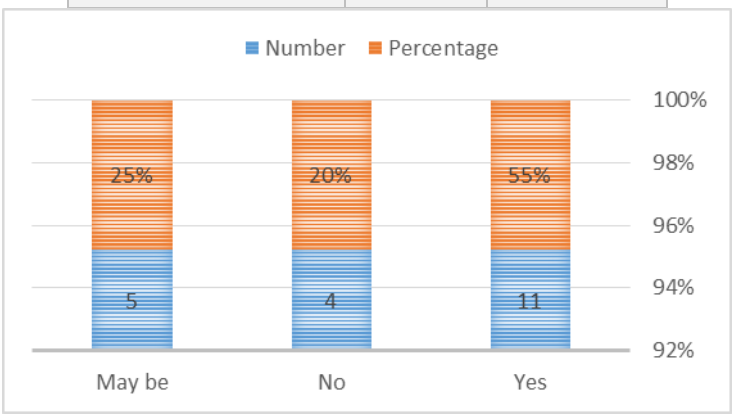
| Opinion about the future of immunotherapy | Number | Percentage |
|---|---|---|
| **Yes** | 13 | 65% |
| **No** | 1 | 5% |
| **May be** | 6 | 30% |




**Commentary:**
The data shows that there is a strong conviction that immunotherapy represents a promising future for cancer treatment, which is in line with global research trends that confirm the continuous development of this field and its achievement of promising clinical results.

**Table 13: Challenges in Access to Modern Cancer Drugs in Tripoli**

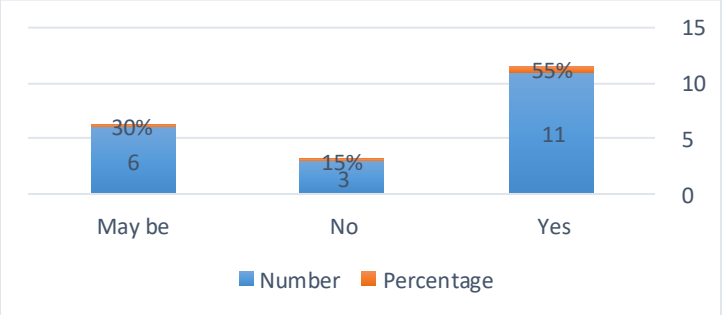
| Having challenges | Number | Percentage |
|---|---|---|
| **Yes** | 11 | 55% |
| **No** | 4 | 20% |
| **May be** | 5 | 25% |




**Commentary:**
The majority of respondents (55%) believe that there are challenges in obtaining modern medicines, which reflects the reality of the Libyan health system, which needs to develop supply networks and establish partnerships with international pharmaceutical companies.

**Table 14: Adequacy of immunotherapy for patients not responding to chemotherapy**

| The appropriateness of immunotherapy | Number | Percentage |
|---|---|---|
| **Yes** | 11 | 55% |
| **No** | 3 | 15% |
| **May be** | 6 | 30% |

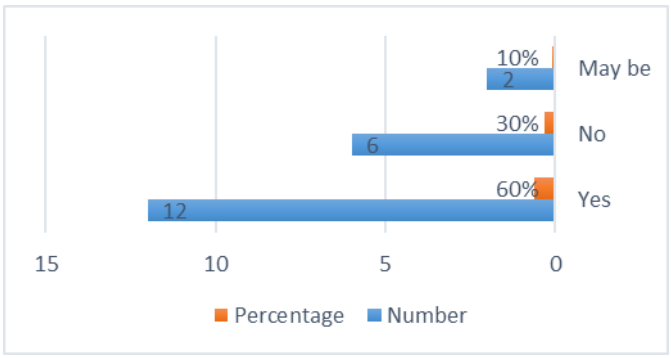



**Commentary:**

The results indicate that the majority of participants consider immunotherapy an important alternative for patients who do not respond to chemotherapy, highlighting the importance of its use as a second- and third-line treatment option for cancer.

**Table 15: Knowledge of how immunotherapy works at the cellular level**

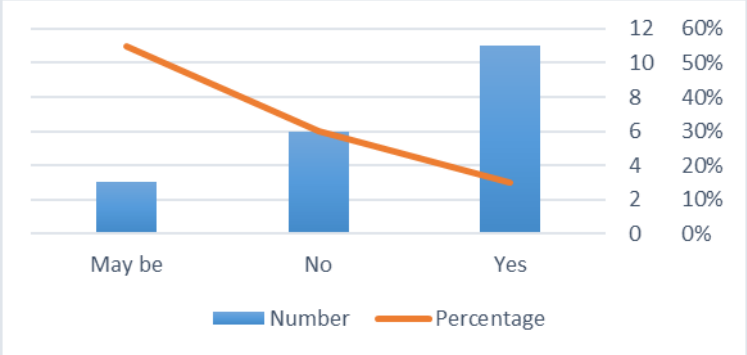
| Knowledge of cell therapies | Number | Percentage |
|---|---|---|
| **Yes** | 12 | 60% |
| **No** | 6 | 30% |
| **May be** | 2 | 10% |



**Commentary:**
More than half of the participants show an understanding of how immunotherapies work at the cellular level, suggesting that there is a good knowledge base on which to build to expand the use of these new technologies among professionals and patients.

**Table 16: Pharmacist Reliability as a Source for Answering Patients' Questions About Cancer Drugs**

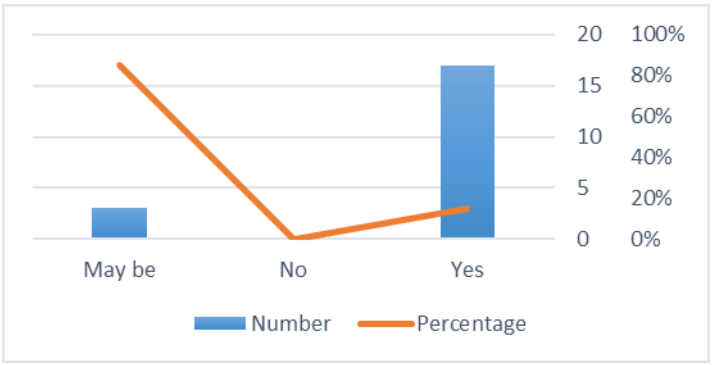
| Reliability of the pharmacist | Number | Percentage |
|---|---|---|
| **Yes** | 11 | 55% |
| **No** | 6 | 30% |
| **May be** | 3 | 15% |




**Commentary:**
The results reflect a general belief in the pharmacist's role as a reliable source of information, which requires strengthening pharmacist training programs on cancer drugs and immunotherapies to ensure accurate and up-to-date information is provided to patients.

**Table 17: Effect of immunotherapy on improving survival rates**

| Opinion on survival rates | Number | Percentage |
|---|---|---|
| **Yes** | 17 | 85% |
| **No** | 0 | 0% |
| **May be** | 3 | 15% |

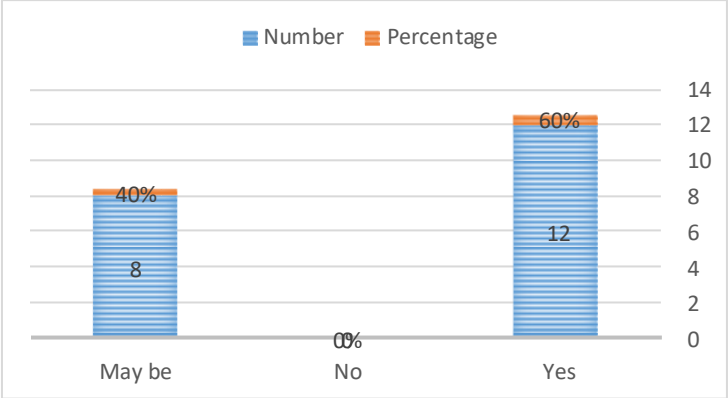



**Commentary:**

The questionnaire shows high optimism that survival rates can be improved using immunotherapy, which is confirmed by several recent clinical studies that have indicated a significant improvement in therapeutic outcomes with the use of immunotherapy.

**Table 18: Possibility of using immunotherapy in the early stages of cancer**

| Opinion about the use of early treatment | Number | Percentage |
|---|---|---|
| **Yes** | 12 | 60% |
| **No** | 0 | 0% |
| **May be** | 8 | 40% |

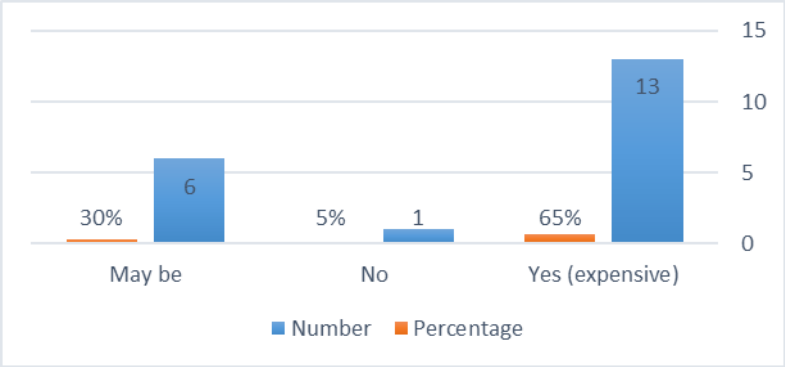



**Commentary:**

The data suggests that there is a positive belief that immunotherapy can be used in the early stages of cancer, although current clinical protocols often focus on its use in advanced stages, which calls for further research in this area.

**Table 19: Evaluation of the costs of immunological cancer drugs**

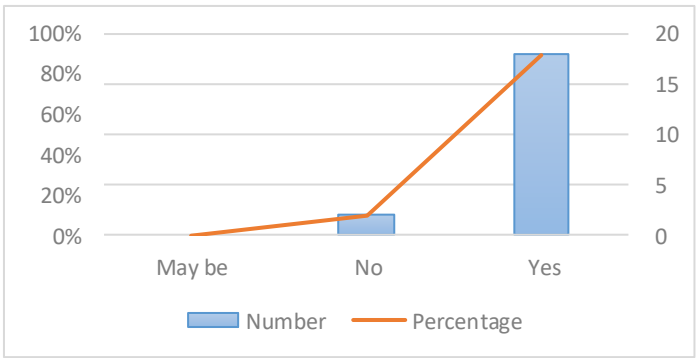
| Opinion about prices | Number | Percentage |
|---|---|---|
| Yes (expensive) | 13 | 65% |
| No | 1 | 5% |
| May be | 6 | 30% |




**Most respondents** believe that immunocancer drugs are expensive, reflecting the economic challenges facing patients and highlighting the need for state support or universal health insurance programs that cover these treatments.

**Table 20: Need to improve scientific research on cancer drugs and immunotherapy in Libya**

| Opinion about scientific research | Number | Percentage |
|---|---|---|
| **Yes** | 18 | 90% |
| **No** | 2 | 10% |
| **May be** | 0 | 0% |

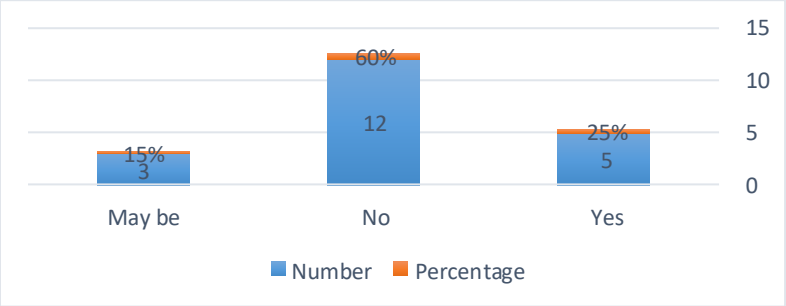


**Commentary:**

The results show a near-unanimous conviction of the need to develop local scientific research on cancer drugs and immunotherapy, which requires greater investments in research centers and clinical studies in Libya.

**Table 21: Availability of training programs for pharmacists on immunotherapies in Libya**

| Availability of training programs | Number | Percentage |
|---|---|---|
| **Yes** | 5 | 25% |
| **No** | 12 | 60% |
| **May be** | 3 | 15% |




**Commentary:**

Findings indicate that 60% of respondents believe that there are insufficient training programs for pharmacists in Libya on immunotherapies, highlighting an important educational gap that must be filled through specialized workshops and internationally recognized professional certifications.

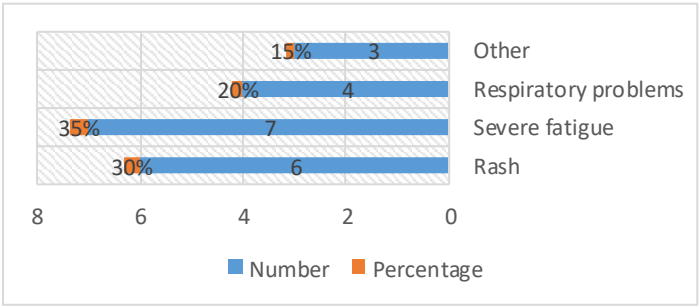
**Table 22: Patients use immunotherapy without consulting a doctor**

| Use without consultation | Number | Percentage |
|---|---|---|
| **Yes** | 2 | 10% |
| **No** | 16 | 80% |
| **May be** | 2 | 10% |


**Commentary:**
The vast majority (80%) of patients do not use immunotherapy without medical advice, which indicates a good health awareness of the importance of clinical evaluation before starting modern treatments, which is positive and should be constantly promoted through awareness campaigns.

**Table 23: Most common side effects of immunotherapy by pharmacists**

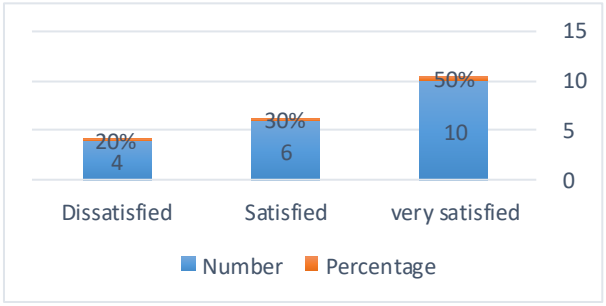
| Type of side effect | Number | Percentage |
|---|---|---|
| **Rash** | 6 | 30% |
| **Severe fatigue** | 7 | 35% |
| **Respiratory problems** | 4 | 20% |
| **Other** | 3 | 15% |




**Commentary:**
Pharmacists have shown that extreme fatigue is one of the most common side effects associated with immunotherapy, followed by rashes, which is consistent with clinical reports documenting these effects as more common, requiring careful monitoring of symptoms during treatment.

**Table 24: Patient satisfaction with the effectiveness of immunotherapy compared to conventional therapy**

| Level of satisfaction | Number | Percentage |
|---|---|---|
| **very satisfied** | 10 | 50% |
| **Satisfied** | 6 | 30% |
| **Dissatisfied** | 4 | 20% |

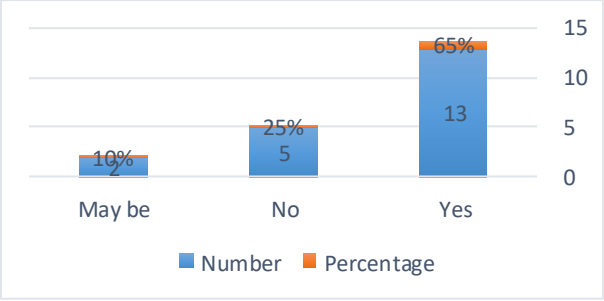



**Commentary:**

The results indicate that 80% of patients express complete or partial satisfaction with the effectiveness of immunotherapy compared to conventional treatment, indicating a change in the general perception of modern treatments and their role in improving quality of life and survival rates.

**Table 25: Patients' knowledge of the difference between chemotherapy and immunotherapy**

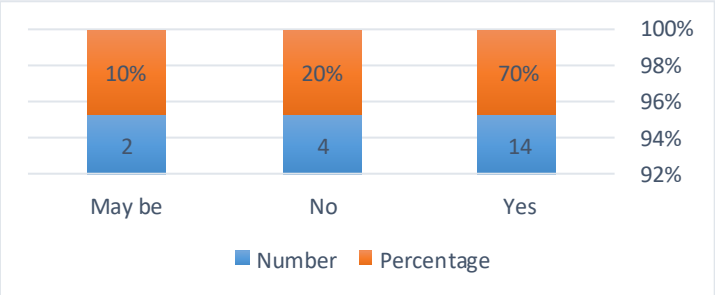
| Having sufficient knowledge | Number | Percentage |
|---|---|---|
| **Yes** | 13 | 65% |
| **No** | 5 | 25% |
| **May be** | 2 | 10% |



**Commentary:**
The results show that about two-thirds of patients have a good understanding of the differences between chemotherapy and immunotherapy, which indicates relative progress in patient awareness, but the continuation of health education programs is necessary to raise the level of knowledge to a higher level.

**Table 26: Willingness to participate in clinical trials of cancer drugs and immunotherapies**

| Willingness to participate | Number | Percentage |
|---|---|---|
| **Yes** | 14 | 70% |
| **No** | 4 | 20% |
| **May be** | 2 | 10% |




**Commentary:**
70% of respondents expressed a desire to engage in clinical trials, reflecting high confidence in scientific research and a strong desire to contribute to the development of new treatments, which is an important indicator of the success of future clinical research programs in Libya.

**Table of comparison between the results of the field study in Tripoli and previous studies**

| figure | Axis | Results of the field study (Tripoli) | What was mentioned in previous studies | Comparison/Comment |
|---|---|---|---|---|
| **1** | **Immunotherapy awareness** | 52.6% are unsure they know immunotherapy, and 36.8% don't know it at all. | Clinical & Experimental Allergy: Public and community awareness is still limited, and education is needed. | A clear match in the low level of awareness of immunotherapy and the need of communities for health education. |

| | | | | |
|---|---|---|---|---|
| **2** | **The effectiveness of oral and immunomodulatory drugs** | 50% believe that oral medications may be more effective than conventional treatments. | Journal of Exp. & Clinical Cancer Research: Drugs have been rated for efficacy and safety to improve immunotherapy outcomes, and studies have confirmed that some combination therapies may increase effectiveness. | Public opinion agrees with recent trends in the classification and development of effective drugs. |
| **3** | **Difficulties in accessing treatment** | 80% believe that access to cancer drugs in Tripoli is limited, and 55% face significant difficulties in obtaining advanced medicines. | Nature Reviews Drug Discovery: Funding and poor infrastructure are major barriers to the development and application of immunotherapy. | The field study confirms local constraints that are consistent with global challenges in this area. |
| **4** | **Side effects** | Extreme fatigue and rashes were the most prominent side effects recorded. | Study 4 (Critical Care): reported symptoms of fatigue, rash, immune and systemic disorders such as CRS and neurological problems. | Consistent results indicate similarity in side effects globally and locally. |
| **5** | **Understanding between chemotherapy and immunotherapy** | 65% understand the difference between chemotherapy and immunotherapy. | Study 3 and Study 2 confirm societal confusion in understanding the differences and recommend better education for patients and staff. | The level of understanding in Tripoli is relatively good, and may be the result of partial awareness campaigns or personal experiences. |

| | | | | |
|---|---|---|---|---|
| **6** | **Scientific Research and Training** | 90% believe it is necessary to develop scientific research in cancer and immunotherapy, and 100% emphasize the importance of training health workers. | Study 1 and 5: emphasize the importance of advancing scientific research, intersectoral collaboration, and improving medical training to improve the use and delivery of mmunotherapies. | Full agreement between the opinion of the participants and the recommendations of the scientific literature. |
| **7** | **Willingness to participate in clinical trials** | 70% of respondents were willing to participate in clinical trials. | Study 2 and 3: Underscore the importance of supporting clinical trials with broad community participation to improve treatment. | A high percentage of preparedness, reflecting a growing community awareness that may invest in supporting future experiences. |
| **8** | **Drug delivery technologies** | They were not directly addressed in the field study. | Study 5 (Nature Reviews Drug Discovery): discussed the challenges of immunotherapy delivery and the importance of technologies such as nanotechnology and cell-dependent systems. | Lack of awareness or local mention of this area, and it is recommended that it be included in education and development plans. |
| **9** | **Family and hereditary influence of cancer** | 52.6% have a family history of cancer. | The exact ratio has not been mentioned in previous studies, but many studies emphasize the importance of knowing family history for targeted therapy and early screening. | A realistic result that reflects the importance of raising awareness of early screening among those with family history. |

## Results

**Demographics:**

Males constituted 68.4% of the sample, and females 31.6%.

The majority of participants were between the ages of 21 and 40.

**Family history of cancer:**

52.6% have a family history of cancer.

**Knowledge of immunotherapies:**

52.6% were unsure they knew immunotherapy, and 36.8% didn't know about it at all.

**Effectiveness of oral and immunomodulatory drugs:**

50% believe that oral medications may be more effective than conventional treatments.

**Challenges and obstacles:**

80% believe that access to cancer drugs in Tripoli is limited.

55% cited significant challenges in accessing advanced medicines.

**Side effects and knowledge:**

Severe fatigue and rashes were the most prominent side effects recorded.

65% of patients understand the difference between chemotherapy and immunotherapy.

**Research and Community Role:**

90% believe it is necessary to improve scientific research on cancer and immunotherapies.

100% stressed the need for additional training for health workers on immunotherapies.

**Clinical trials:**

70% are willing to participate in clinical trials of new drugs.

## Recommendations

**Increasing health education programs:**

The need to organize awareness campaigns on immunotherapy, targeting patients and the medical community alike.

**Improving the availability of modern medicines:**

Support government and private efforts to import and provide cancer drugs and immunotherapies in sufficient quantities and at reasonable prices.

**Training of health personnel:**

Establishing specialized training programs for pharmacists and doctors on the latest developments in immunotherapies.

**Encouraging scientific research:**

Enhance funding and support for scientific research projects related to cancer in Libya, with the establishment of specialized research centers.

**Opening channels for clinical trials:**

Facilitate patient participation in international and local clinical trials while providing the necessary ethical safeguards.

**Awareness of the side effects of treatments:**

Publish simplified guides on how to deal with the side effects of immunotherapy to ensure patient comfort.

## The end

The results of the study showed that there is an initial awareness about immunotherapies among patients and the medical community in Tripoli, with the urgent need to enhance this awareness through integrated educational programs. The results also revealed clear challenges in the provision of modern cancer drugs, which calls for unremitting efforts to develop health and research infrastructure.

The study suggests that the future holds promising possibilities for the adoption of immunotherapy in Libya, provided that investment in education, facilitating access to medicines, and stimulating scientific research are spurred.

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# Supplements

**Questionnaire on cancer drugs and immunotherapy**

**In the name of God the most Merciful, the most Compassionate**

**Either after:**

Cancer drugs and immunotherapy are two of the most important areas of medical research and treatment in modern times. Scientific knowledge about these treatments is constantly increasing, improving the outcomes of cancer treatment and reducing the side effects associated with conventional chemotherapy. This survey aims to collect opinions and assessments from students and practitioners in the Department of Pharmacy in Tripoli about cancer drugs and immunotherapy, in order to understand their awareness and understanding of these treatments and methods of use.

**1. Personal Data :**

1؟What is gender

male ☐ female ☐

2؟What is age

☐ I'm ☐ 20 ages 21-30, ☐ 31-40, ☐ 41-50, ☐ 51-60, ☐ a.m. 60.

:Family history of cancer .2

3Do you have a family history of cancer? ☐ Yes ☐ No

3. Type of cancer:

What type of cancer have you been diagnosed with?

☐ Breast Cancer ☐ Lung cancer ☐ Colon cancer ☐ Prostate cancer ☐ leukaemia ☐ Other types: _____

4. Timing of diagnosis:

When were you diagnosed with cancer?

☐ Less than 6 months ☐ 6 months - year ☐ 1 - 2 year ☐ More 2 year

5. Cancer stage:

Have you been diagnosed with cancer at an early or advanced stage?

☐ Early ☐ stage Advanced ☐ stage UncertainD

Do you have knowledge of cancer immunotherapy?

☐ Yam ☐ La ☐ Rebma

Do you think oral medications to treat cancer may be more effective than conventional treatments?

☐ Yam ☐ La ☐ Rebma

Do you have knowledge of different types of immunotherapies such as antibody therapy or T cell therapy?

☐ Yam ☐ La ☐ Rebma

Do you think immunotherapy has fewer side effects than chemotherapy?

☐ Yam ☐ La ☐ Rebma

Do you think cancer drugs should be readily available to patients in Tripoli?

☐ Yam ☐ La ☐ Rebma

Do you think immunotherapy is a future option for cancer treatment?

☐ Yam ☐ La ☐ Rebma

Do you think there are challenges in accessing modern cancer drugs in Tripoli?

☐ Yam ☐ La ☐ Rebma

Is immunotherapy a suitable alternative for patients who do not respond to chemotherapy?

☐ Yam ☐ La ☐ Rebma

Do you have knowledge of how immunotherapies work at the cellular level?

☐ Yam ☐ La ☐ Rebma

Do you think a pharmacist is a reliable source for answering patients' questions related to cancer drugs?

☐ Yam ☐ La ☐ Rebma

Do you think immunotherapy helps improve patients' survival rate?

☐ Yam ☐ La ☐ Rebma

Can immunotherapy be used in the early stages of cancer?

☐ Yam ☐ La ☐ Rebma

Do you think immunotherapy drugs are expensive?

☐ Yam ☐ La ☐ Rebma

Do you see a need to improve research on cancer drugs and immunotherapy in Libya?

☐ Yam ☐ La ☐ Rebma

Do you think public awareness of immunotherapies is sufficient in the Libyan medical community?

☐ Yam ☐ La ☐ Rebma

Is more training needed for healthcare providers on immunotherapy?

☐ Yam ☐ La ☐ Rebma

Does the patient need constant follow-up while using immunotherapy?

☐ Yam ☐ La ☐ Rebma

Is immunotherapy more effective in patients with a family history of cancer?

☐ Yam ☐ La ☐ Rebma

Do doctors in Libya adequately recommend the use of immunotherapy?

☐ Yam ☐ La ☐ Rebma

Is scientific research on cancer drugs and immunotherapy in Libya progressing well?

☐ Yam ☐ La ☐ Rebma